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AGRICULTURAL ENGINEERING

VOL 18, NO 2 EDITORIALS FEBRUARY 1937

The Agricultural Engineer Grows Up

THE agricultural engineer is following a normal curve of growth. He is growing up.

Something over thirty years ago, he was admitted to a new field and, for a while, was awed and thrilled by the glamor and immensity of "an engineered agriculture."

His first moves were to get acquainted with the divisions of the field and with the tools within the field. He has been kept busy ever since cleaning up, redesigning, improving those tools. Better tractors, stronger barns, better ditches, and more power are the results.

Now the youthful stage is passing and he is beginning to ask, "What's this all about? What is the relation of this, that I am doing, to the whole business of farming? Is this a part of the whole, or only a more or less important sideshow?" The idea is beginning to dawn that it may be neither of these, but the *whole show!*

L. F. Livingston, addressing the North Atlantic Section of the American Society of Agricultural Engineers last October[1], spoke of the "delicate balance between the size of farm, the type of farming, and the number of resident workers available" as an engineering matter. He spoke modestly at first: "Agricultural engineering is a cooperative profession." But soon came the fundamental thought: "The responsibility facing the agricultural engineer is to reach every farmer on his own farm with all the sound agricultural engineering information now available." And the reason for reaching him is not just to show how much the engineer knows; it is for the sake of taking the lead in the *management of agriculture.* "We can be of more financial service to the farmer than any other group dealing with agriculture."

Thus, agricultural engineering passes out of the formative, tool-making stage into the interpretive, productive, tool-using stage.

At the same North Atlantic Section meeting, three other papers were given by men from diverse backgrounds and widely separated geographically, but speaking the same thoughts. Geo. R. Boyd[2] said that "the farm factory as well as a shoe factory must be so organized, equipped, and coordinated that each one of the separate parts fits into the production program and is coordinated with all of the other parts." He showed, by precept and example, how the engineer can take the lead in building this coordinated production program. W. A. Harper analyzed farm power contracting as farm "standby service" which gives to the farmer sufficient power for timeliness of operation without bogging down in overhead—another attack on the problem of coordinated production programs. L. G. Heimpel discussed the agricultural engineer as a farm manager. (See elsewhere in this issue.) The agricultural engineer must be one who sees agriculture as a whole; "the questions of size of business, balance between the various units, and efficiency in use of power and labor, are factors so closely interwoven that the engineer, in considering the organization of a farm, cannot consider one without at the same time including all three."

I commend to agricultural engineers the thoughtful reading of these papers. The agricultural engineer is moving from "the services of engineering *in* agriculture" toward "the engineering *of* agriculture."

HAROLD E. PINCHES
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Connecticut State College.

[1]Engineering Frontiers in Agriculture, by L. F. Livingston. AGRICULTURAL ENGINEERING, December 1936, vol. 17, no. 12.

[2]Engineering Aspects of Farm Operating Efficiency by Geo. R. Boyd, AGRICULTURAL ENGINEERING, January 1937, vol. 18, no. 1.

Dehydration by Refrigeration

SEVERAL references were made, during the winter meeting of the American Society of Agricultural Engineers, to refrigeration as a method of dehydration, Advances in the technique and widespread use of mechanical refrigeration, and the urgent demands for economical means of dehydration of various agricultural products, make it a live subject for consideration by agricultural engineers.

Heating received its start as a simple and obvious method of dehydration for many purposes. It has been used so commonly and extensively for drying purposes that the possible advantages of other methods of dehydration are in danger of being overlooked, even by trained research men.

Refrigeration has several possible advantages over heating as a means of dehydration for certain purposes and conditions. The germination-reducing, case-hardening, stomata-closing, and vitamin-destroying effects of high temperatures are too well known to require amplification. So is recondensation trouble. Dehydration by refrigeration avoids dangerously high temperatures and can be accomplished without subjecting most products to be dehydrated to dangerously low temperatures. By freezing water out of air, and letting the water-carrying capacity of that air increase as it returns to normal temperature, the recondensation evil is avoided. In cases of product heating due to unwanted chemical action, dehydration with hot air may increase the evil, whereas dehydration with cold air would minimize it.

We are not saying that dehydration by refrigeration is ready for adoption as a farm practice, but we suggest it seriously as another field for agricultural engineering research.

Conservation or Floods

"OLD MAN RIVER" has risen again to shout down angrily the puny voices of men whose wishful thinking leads them to say that soil and water conservation is being overemphasized. He will do so repeatedly until he is understood and remembered.

The plainest, most unpleasant fact of the situation crying for public recognition, is that major changes have taken place in the very natures of small and large watersheds, which increase the rate of runoff and the probability of destructive floods.

People of the uplands and lowlands of all watersheds have a mutual interest in soil and water conservation and flood prevention.

Theirs is the choice of whether to master or be mastered by running water; whether to continue the short-sighted opportunist practice of cutting economic corners for the sake of the immediate dollar, or to take farsighted steps to control runoff; whether to invest dollars and lives in preventive measures, or to lose them unconditionally and surely in repeated disasters; whether to abandon the lowlands, and eventually the uplands, to the destruction man himself has initiated, or to start living, planning, and working more constructively and less destructively; whether to fight floods as small trickles in the uplands or as raging torrents in the lowlands.

The work of developing and applying cooperatively the necessary means of control might be less spectacular than flood rescue missions; but it could be done under more pleasant conditions and with fewer incidental funerals.

The Source of Prosperity

WHEELER McMILLEN packed a lot of engineering-economic sense into a few paragraphs of an address that won the acclaim of the National Grange meeting in Columbus, Ohio, last November. Relative to the interrelationships of agriculture, industry, employment, and prosperity, he said, in part:

"Jobs are the result, directly or indirectly, of goods and materials, of tangible things that not only have to be produced but have to be hauled, loaded, transported, warehoused, manufactured, processed, packaged, wholesaled, accounted for, financed, retailed, delivered and serviced. Those are the processes that make employment. They demand materials to be handled. Where do these materials come from? The raw materials of all industry come from the soil, the mines, the forests and the seas. But principally they come from the soil.

"The philosophy of advancement calls for increasing quantities of needed and usable materials that will first enhance the incomes of all farmers, both of the fortunate two millions and of the less fortunate four millions; and that then, in the domains of commerce, transportation and manufacture, will make real jobs for millions of the urban unemployed.

"The philosophy of advancement realizes that as this process gathers momentum, the new money returned to the farms will quickly flow through the channels of trade in exchange for industrial goods, thus calling for more raw materials, more jobs in factories and stores and transportation and service, and thus lay the solid foundations for permanent employment."

Therein is stated succinctly the philosophy of farm chemurgy, and implied, an obligation to agricultural engineers to do their part in helping farmers provide additional raw materials for industry.

Repowering Agriculture

"ONE swallow does not make a summer" according to the old proverb; and highlines alone do not make rural electrification, G. C. Neff reiterates, in effect, in his paper in this issue.

Various agricultural engineers have said the same thing repeatedly, but it bears repeating with all the new eloquence that can be applied. The intriguing versatility of electricity, and the wide range of its demonstrated applications, creates a perpetual temptation, to the uninitiated, to bring highlines within the farmers' reach and trust to electrical magic to create the agrarian utopia.

As pointed out by Mr. Neff, it will take much careful agricultural engineering at the point of power application to avoid unnecessary expense, failure, and disappointment. Rural electrification is the repowering of an industry. It is the application of a highly engineered form of power to an industry which is still in the early stages of using engineered power of any sort. It is much more than the casual connection of lights and conveniences.

From an agricultural engineering point of view, rural electrification is the complexity of agricultural science multiplied by practically the total range of electrical phenomena and engineering development.

Progress in Terminology

AIR conditioning is more than a step forward in engineering technique, it marks progress in engineering terminology.

Engineering nomenclature is naturally descriptive. "Air conditioning" describes an engineering objective. It does it so clearly and simply as to definitely tie together the fields of heating, refrigeration, ventilation, and humidity control; and to minimize the danger of efforts being wasted in these fields due to the lack of a clear objective.

"Conditioning" may become a key word in other agricultural engineering activities. Definite research progress is being made in what might be called "soil conditioning." Water is another primary substance subject to "conditioning" for various uses. "Product conditioning" looks still more directly toward ultimate objectives. A more apt word than "conditioning," to characterize engineering mastery of physical environments and results, would be hard to find.

Effect of Tractor Tire Size on Drawbar Pull and Travel Reduction

By L. W. Hurlbut and C. W. Smith

IN AGRICULTURAL ENGINEERING for April 1936 (vol. 17, no. 4) we presented an article on this same subject, based on studies made on the tractor testing course of the department of agricultural engineering, University of Nebraska, on a freshly plowed field on the English farm, and on a freshly plowed field on the Hoffman farm. In 1936 we continued this work, adding two footings radically different from those heretofore used. This additional work is reported here, and should be considered supplementary to that previously reported.

These two traction footings were found on the Dewey Schaffer ranch, 15 mi northwest of Chambers, and about 150 mi northwest of Lincoln, Nebraska. It is in the eastern end of the sandhill region of the state. One condition chosen for tests was a level field which had been listed to corn in the spring, but due to drought and wind the west half had blown out and the sand was drifting considerably at the time we pulled in for tests. The listing had been done east and west, but due to cultivation and wind, no traces of the listed furrows remained. We first disked the field diagonally and then did our testing north and south. The soil of this field is classified by the University soils department as fine sand. Fig. 1 gives a view looking southeast across the field. The testing equipment can be seen at a distance of about 1/4 mi coming north. Fig. 2 shows the testing equipment at the end of a run. A few remnants of corn plants can be seen at this end of the course.

The top 4 in of soil were very dry, the moisture content being in the hygroscopic region, but below that the sand was always moist. The field was not large enough to make possible the taking of all data without using parts of the field more than once, but due to the nature of the sand it was our opinion that it did not pack and that traction conditions were changed little, if any, by traveling over it.

The other condition chosen for test was a wild hay meadow stubble, from which the hay had been cut and removed about two weeks previously. The soil from this meadow is classified as a loamy fine sand. While they are still referred to as wild hay meadows, tame grasses are coming into these wild meadows more and more. A piece of sod from this meadow showed the following: 1/8 to 1/4 in of dry thin moss, sedges, bluegrass, timothy, redtop, red clover, sloughgrass, big bluestem, little bluestem, and Indian grass.

The root system of these grasses makes a dense sod from 2.5 to 5 in thick. Below that there is very little binder in the way of roots or organic matter for the fine sand which is basic throughout the region. The meadow and the field are adjacent and originally were the same soil type. Fig. 3 is a view looking east across the meadow. The testing equipment is shown at a distance. The tracks made in testing are clearly visible.

Equipment used in making the test was identically the same as had been used the preceding year and consisted of five sizes of pneumatic tractor tires; 9.00x24; 9.00x36; 11.25x24; 12.75x24; 13.50x24; and a set of steel wheels and lugs. A Douglas truck was the foundation of the drawbar loading unit. The rear weight of the tractor was kept constant at 2780 lb for all tests. One forward gear was used for all tests, namely 3rd gear. The tractor was the Minneapolis-Moline "JT".

The object of the tests was to get more information on the effect of tire cross section on the drawbar pull of a tractor. In doing this work with this object in view, it seemed advisable to keep the weight of the rear end of the tractor constant for all tests. In doing this a weight was chosen which was somewhat greater than the manufacturer's recommended load for the smallest tires, but less than that for the largest. No overload used, however, was anywhere near an amount which would be immediately injurious to the tires. The only reason for dwelling on this point is to make sure that no one concludes, after reading this, that the loads used on the tires are those being recommended by us. They are not. They were merely chosen as being convenient for our experimental purposes. We know that more drawbar pull could have been secured with greater weight on the rear end of the tractor and that less drawbar pull would have been secured with less weight. But in order to compare the drawbar pulls of all tires, a constant weight was chosen, and 2780 lb was the one we used.

Results are presented herein in graphical form supplemented by tables and comments.

Authors: Respectively, instructor and professor of agricultural engineering, (Mem. ASAE) University of Nebraska.

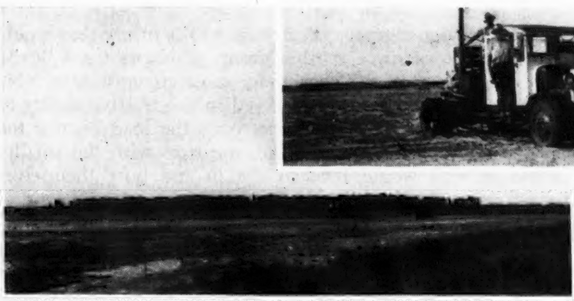
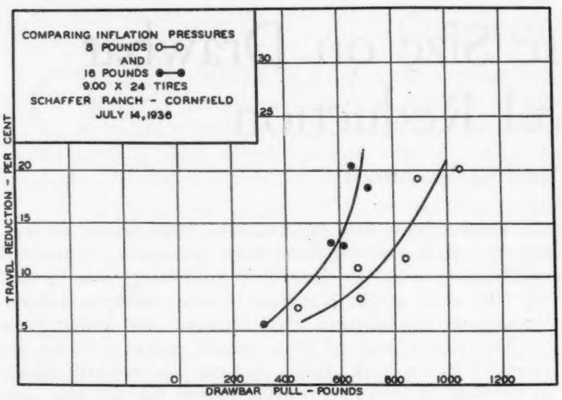
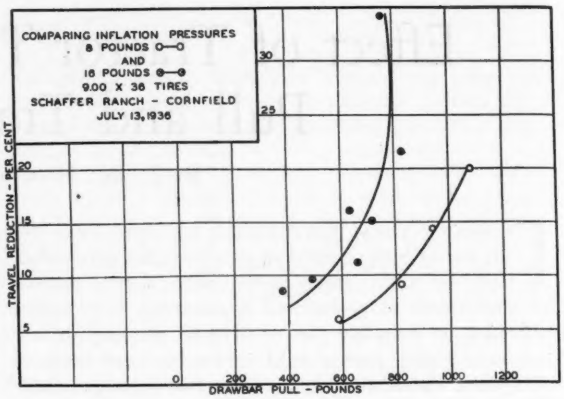
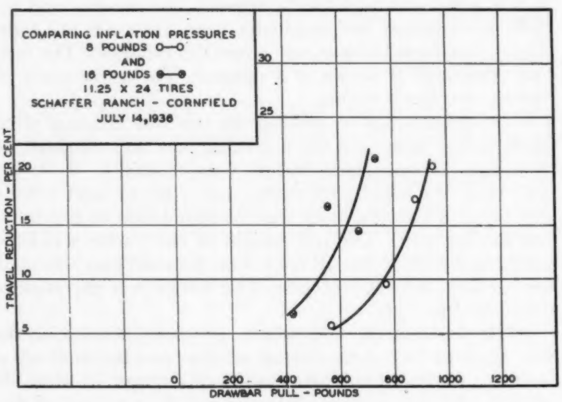
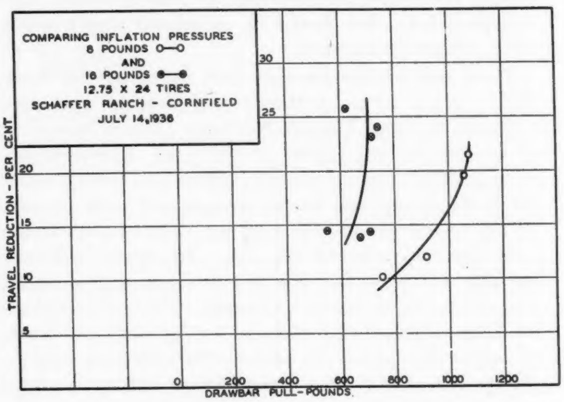


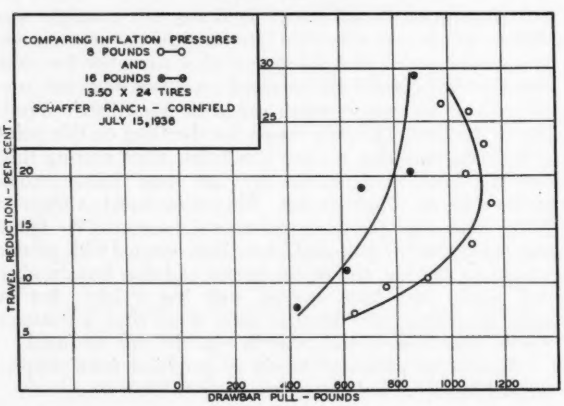
FIG. 1 (LEFT) ABANDONED CORN FIELD ON DRY, FINE SAND; ONE OF THE TRACTION FOOTINGS OF THE TESTS. FIG. 2 (INSET) TEST TRACTOR AND DRAWBAR LOADING UNIT. FIG. 3 (RIGHT) STUBBLE MEADOW FOOTING SHOWING TRACKS MADE IN TESTING

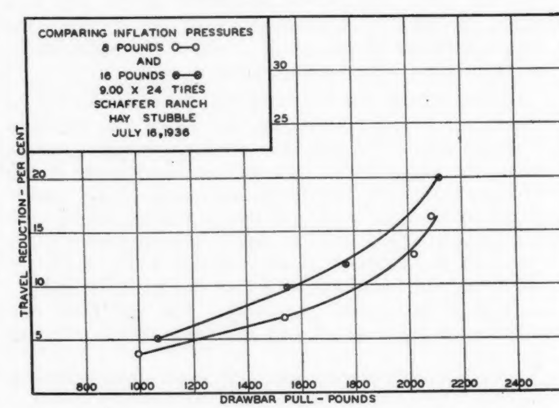








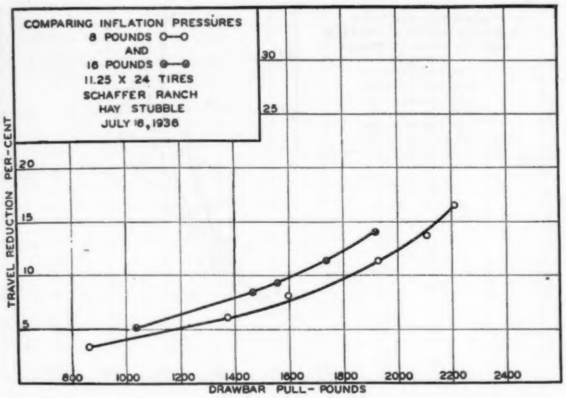


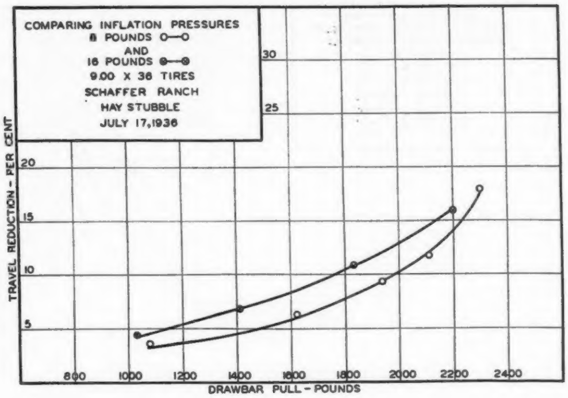


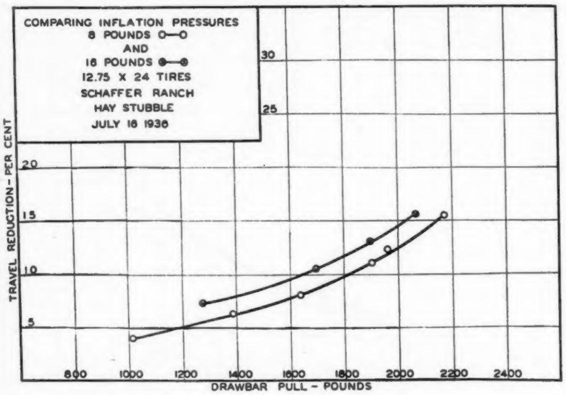
A group of charts is presented comparing the drawbar pull of each tire when carrying 8 lb of air pressure, with the drawbar pull when carrying 16 lb of air pressure, for both the cornfield and the hay stubble. These show that 8-lb inflation pressure gives greater traction than 16-lb inflation pressure for both footings and for all tires.

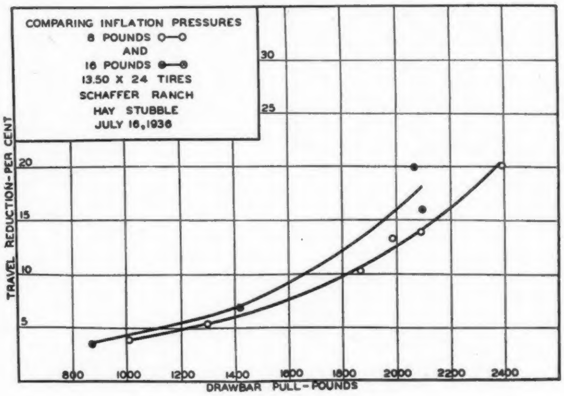
Another group of charts is presented comparing all tires in drawbar pull, first at 8-lb inflation pressure and then at 16-lb, both for the field and the stubble. A curve for steel wheels is plotted with the rubber tire data, and for the cornfield it is interesting to note that the steel wheel is better than rubber with 16-lb inflation pressure, but not so good as the rubber with 8-lb pressure. Where curves for steel are shown on the charts for the hay stubble, they were not carried to high slippage on account of the injury they would do to the meadow. In this group of charts the 9.00x36 tire stands out as the best under most circumstances. No great difference could be observed in the tractive ability of the others. It was evident that once the load became too heavy to be pulled in the sand, the tires with the smaller cross sections would tend to dig in and bury themselves much more rapidly than those with larger cross sections.

A third set of charts compares the delivered horsepower of all tires, first using 8-lb inflation pressure, then 16-lb inflation pressure. As was pointed out in AGRICULTURAL ENGINEERING for April 1936, the tires giving the largest effective wheel diameters give the greatest horsepower. With the drawbar pull approximately the same, the horsepower









would vary as the rate of travel. The drawbar pull with 16-lb inflation pressure was enough below that for 8 lb that the delivered horsepower at 8 lb exceeded that at 16 lb definitely.

Two charts compare the drawbar pulls with tire cross section. In the chart for the cornfield there seems to be a slight tendency for the curves to lean to the right, indicating a small increase in drawbar pull with tire cross section. But in the chart for the hay stubble the curves are practically vertical, indicating no difference in traction due to tire cross section. To avoid a misunderstanding of this conclusion, we call attention to the fact that the manufacturers give the weight-carrying capacity of the large cross section tires as greater than for the small ones. We have shown previously that the drawbar pull is proportional to the weight on the traction wheels. Since the large tires have greater weight-carrying ability, if both large and small are weighted to capacity, the large ones would be able to exert the greater drawbar pull.

Two charts compare the effective wheel diameters with drawbar pulls. These show a slight advantage in drawbar pull for the larger diameter tires. Where the graphs indicate that this advantage is small, we believe there is room for considerably more work on this phase of the subject.

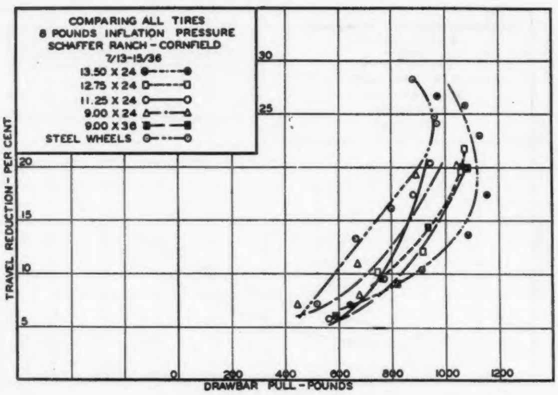
Since the rear end static weight of the tractor was the same for all tires, any difference in traction was due to the tire and not to there being more weight in one case than another. The height of the drawbar was kept constant at 8 in above the ground. An interesting ratio is that of the drawbar pull to the static weight on the traction tires, and which we are calling the coefficient of traction. As stated before, this work is merely a continuation of that done in 1935 and previously reported in this journal. Therefore, in tabulating some coefficients of traction, we have included the work of 1935.

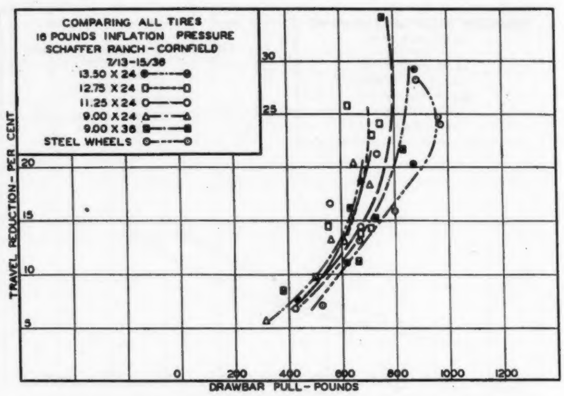
It is interesting to note that the hay stubble proved to be the best traction surface we have thus far encountered.

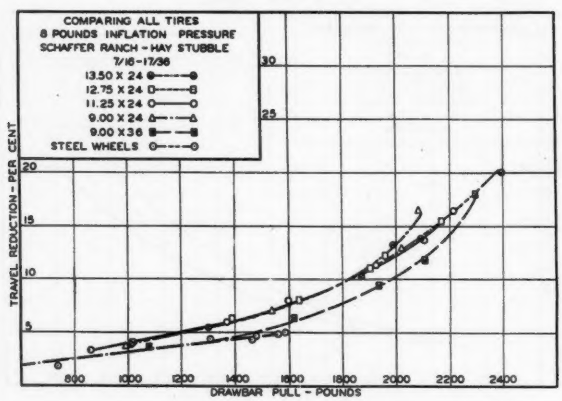
We believe we have presented here a group of traction surfaces, some one of which will approach fairly closely almost any general farm condition of traction likely to be encountered; and that if a tractor user will use the coefficients of traction presented here, it will be possible for him

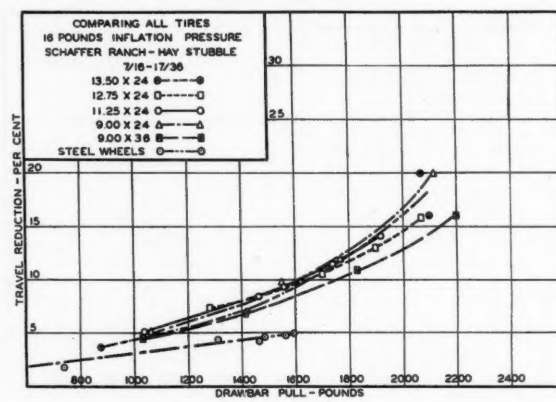
TABLE 1. COEFFICIENTS OF TRACTION OF TRACTOR TIRES

Place of test	Coefficient of traction Drawbar pull ÷ static weight on traction wheels 8-lb inflation, per cent	16-lb inflation, per cent
Tractor Testing Course, July 1935	52	57
Tractor Testing Course, August 1935	52	56
English farm (Freshly plowed wheat stubble, August 1935)	39	34
Hoffman farm (Plowed wheat stubble, August 1935)	48	38
Schaffer cornfield (Very sandy soil, July 1936)	35	24
Schaffer hay stubble (Dry and firm, July 1936)	79	74









to tell in advance almost exactly what he will be able to do with pneumatic tractor tires.

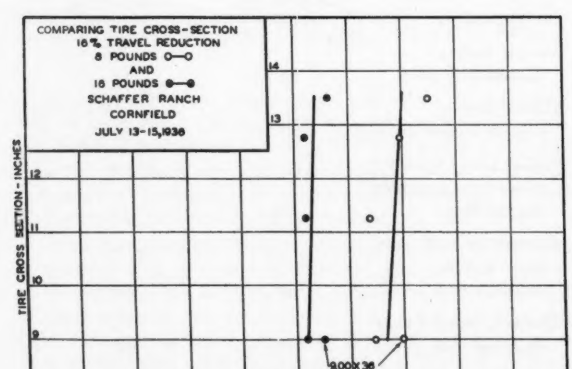
Table 2 is presented as an analysis that should not be taken too seriously on account of small differences between rankings. However, it throws general light on the results of this work.

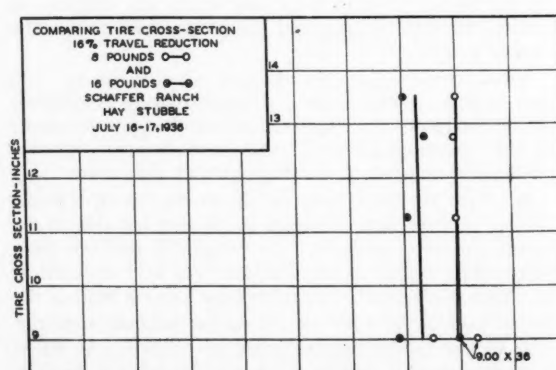
The smaller the sum of the points indicating rank, the higher the standing of the tire so far as drawbar pull is concerned. Therefore, from Table 2 the tires rank in the following order:

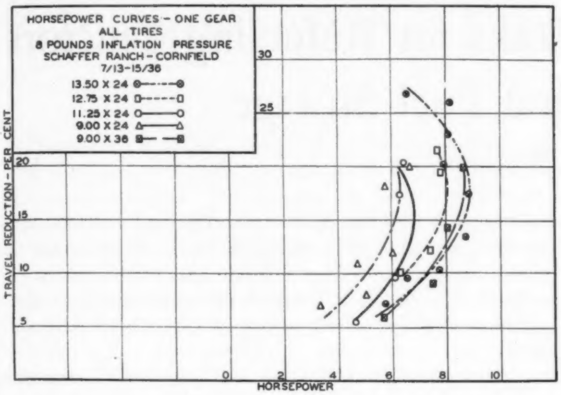
(1) 9.00 x 36,
(2) 13.50 x 24,
(3) 12.75 x 24,
(4) 11.25 x 24, and
(5) 9.00 x 24.

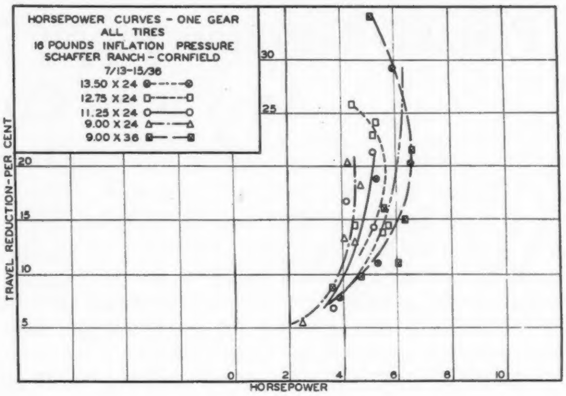
TABLE 2. RANKING TIRES BY DRAWBAR PULL AT 16 PER CENT TRAVEL REDUCTION

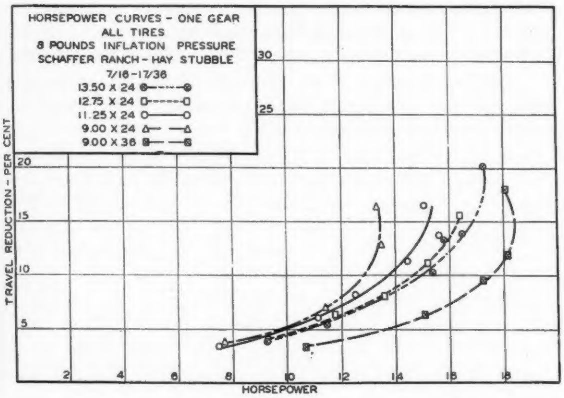
Place	Inflation pres-sure, lb	9.00x24	Rank	11.25x24	Rank	12.75x24	Rank	13.50x24	Rank	9.00x36	Rank
Cornfield	8	895	4	880	5	990	3	1100	1	995	2
Schaffer Ranch	16	640	5	645	4	655	3	725	1	705	2
Hay stubble	8	2100	5	2195	3	2190	4	2200	2	2265	1
Schaffer Ranch	16	1975	5	2010	3	2085	2	2005	4	2200	1
			19		15		12		8		6

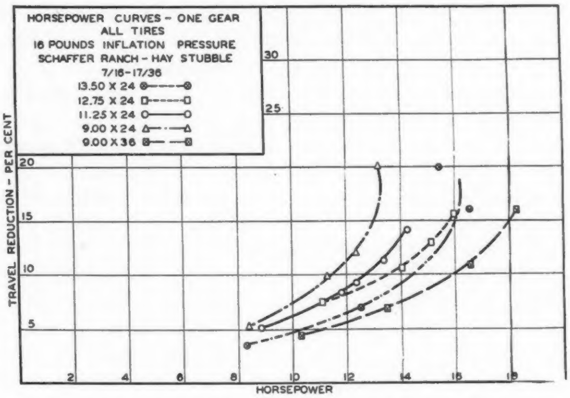








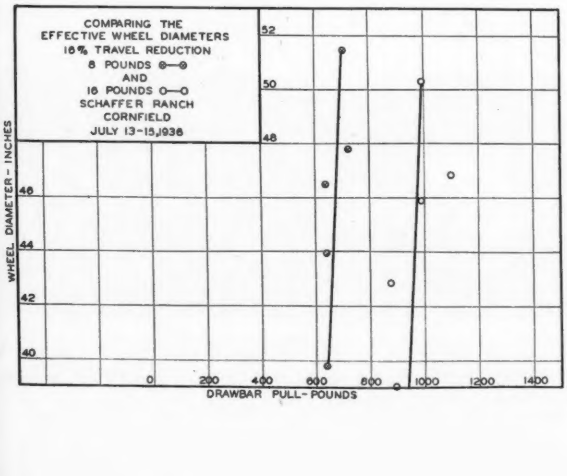


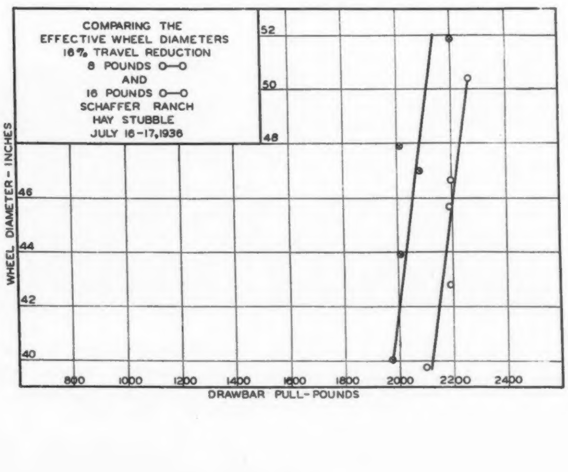


According to the manufacturers, tires of large cross section can carry greater loads at low inflation pressures than those of small sections. It is then evident that should a certain tractor with a known rear weight not have sufficient traction with a given size of pneumatic tire, traction may be increased up to the capacity of the tire to carry weight, by adding weight to the tractor; and that more weight can be added and consequently, more traction secured by using larger tires. This becomes a simple mathematical calculation and is limited only by engine power, and one's ability and willingness to buy larger tires and additional weight for the tractor.

In comparing tire sizes there are undoubtedly several factors which could be used such as riding quality, soil packing, plant clearance, drawbar pull, etc. This article has been confined to the comparison of one characteristic, namely, drawbar pull. It has not been the aim to minimize the others.

We venture the guess that most users will not be interested in going after the maximum possible drawbar pull by using the maximum static weights and the maximum available tire sizes, but will be happy to take the tractor very much as it comes from the manufacturer, with a size of tire having a liberal weight-carrying capacity and a small amount of additional weight which can be attached.





Portable Gasoline Supply Tanks for Refueling Tractors Away from Central Fuel Storage

By D. G. Williams

WE EXPERIENCED some difficulty in satisfactorily handling gasoline from our central tank storage to tractors and other power units operating at some distance from the central storage, until we devised and put into operation the portable supply tank, shown in the accompanying illustrations.

These portable supply tanks are made up of 50-gal steel drums mounted on rubber-tired running gear with suitable provision made for attaching them to the rear of tractors, trucks, or automobiles for hauling to and from the fields where the tractors are working.

The steel drums were secured from a local oil distributor and had to be cleaned out. A faucet with locking device was fitted and spot welded to a threaded nipple which had previously been welded into one head of the drum. Diametrically opposite in the same head, another threaded nipple was welded into place for the filling pipe connection which was closed off at the top with a plug cock with locking device. A branch was welded onto the filling pipe for a relief valve. When assembled all joints were spot welded to prevent tampering.

The drum was mounted on a wooden cradle and was held in place with two iron straps. The cradle was mounted on the front axle of a Model T Ford. These axles and wheels were secured from a local "grave yard" for a few dollars. The steering knuckles were welded into fixed positions and the wheels equipped with cheap pneumatic tires.

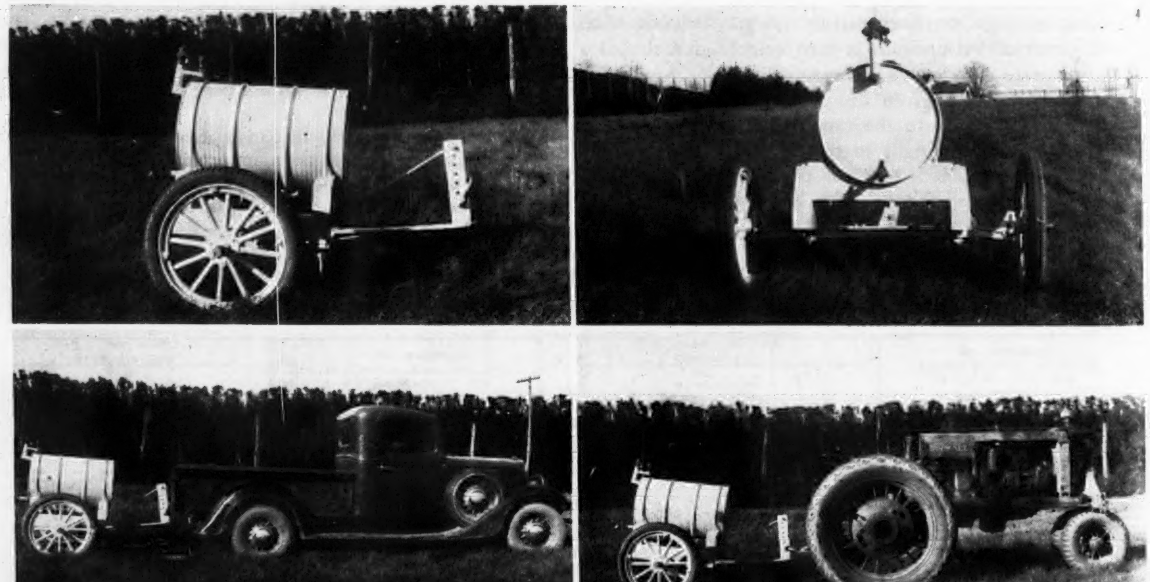
The connecting bars were made of heavy strap iron well braced to reduce to a minimum any chance of the tank being bumped, and possibly ruptured, by the hauling vehicle. The connecting bars were also arranged so that connection could be made to vehicles of different heights.

Folding supports were provided under the connecting bars so that the tanks could be made to set horizontal when placed in the fields for use.

We have had two of these portable tanks in use since last spring, and since most of our gasoline consumption by tractors and power units takes place a mile or more from the central storage, we have found them useful, economical, and much safer than handling the gasoline in small cans on trucks or in automobiles.

The two portable tanks serve four tractors regularly, and two portable power units during threshing and baling periods. The locking devices on the connections to the tanks permit them being left in the fields at night when this is desired.

Author: Chief engineer, Trojan Powder Co.



FOUR VIEWS OF 50-GAL PORTABLE GASOLINE SUPPLY TANKS USED ON TROJAN FARMS TO SERVICE TRACTORS OPERATING AT A DISTANCE FROM THE CENTRAL TANK STORAGE OF THE FARMS. IMPORTANT FEATURES SHOWN INCLUDE DRUM MOUNTING, HITCH CONSTRUCTION, FILLING PIPE AND AIR VENT, AND LOCK-EQUIPPED DRAIN COCK

Instruments for Farm Structures Research

By W. V. Hukill

FOR OBTAINING results in structures research investigations we must depend pretty largely on instrument readings. The selection of proper instruments, their use, and the application of the readings are very important items in conducting such studies. Many problems in farm structures are related to establishing or maintaining proper environments for housing the farm family, protecting farm animals, or curing or storing farm products. In many cases the controlling environmental factors are temperature, humidity, and sometimes air movement.

In selecting instruments for any given purpose it is almost always necessary to compromise between that which is desired and that which is readily available. Since new problems are continually arising, it is to be expected that existing instruments will not be at hand to fit every need. Old types of instruments must be adapted or new ones developed. It is seldom that an instrument ideal in every respect can be found for any purpose. In spite of this fact, there is often a tendency to assume that, if an instrument is made for a certain purpose, it always answers that purpose. The limitations of the instrument and the conditions under which it will operate properly are easily overlooked. For example, a mercury thermometer is an excellent means for measuring air temperature. However, if a mercury thermometer is hung against the wall of a room, it may or may not show the true air temperature. It may be influenced by direct conduction to or from the wall, or by exchange of radiant heat with the wall or other objects in the room. If the readings are in error, the thermometer may not be at fault. Since thermometers are capable of giving true temperature readings under certain conditions, it is easy to forget that they cannot be depended upon to do so without any forethought. In their use certain conditions are implied, and if these conditions are not fulfilled, the readings may not be correct. Instruments in general are subject to limitations, and if the conditions implied in their use are not satisfied, the results will not be dependable.

For temperature measurements there are a large number of instruments that may be used. Whichever type is chosen, there is often a tendency to put too great faith in the instrument and too little thought to its use and its limitations. The purpose of a thermometer is to measure the temperature of material within which or near which it is placed; however, the thermometer is capable only of indicating the temperature obtaining within its sensitive element, the bulb. This leaves it up to the observer to see that the thermometer temperature is equal to that of the material being observed.

For many purposes, one of the most suitable means of measuring temperature is the thermocouple. Thermocouples have several advantages over other types of temperature equipment for certain uses. Temperatures at a large number of points may be read at a central station. After the equipment required for one thermocouple is acquired, others may be installed with very little additional expense. If a potentiometer is used for making readings, the resistance of the lead wires does not affect the accuracy of the readings. This makes it possible to use any convenient length of wire for each temperature point without the necessity for any correction in the readings. The size of the sensitive part of a thermocouple may be very small, so that temperatures of very small objects or of very local environments may be taken. In this respect, thermocouples are exceptionally adapted for measuring surface temperatures of structural materials such as wood, in which a junction may be imbedded. In recent years instrument companies have developed potentiometers with which thermocouples may be used in field or laboratory experiments with much more facility than was formerly possible.

Thermocouples are subject, of course, to the same limitations as thermometers in general, and, in addition, certain other precautions must be taken in using them. These precautions are simple—so simple that their importance is likely to be overlooked.

A thermocouple reading does not indicate a temperature directly, but only a temperature difference between the two junctions, so it is necessary to have a known reference temperature to which one of the junctions is exposed. A mixture of ice and water is often used for this purpose, because ice and pure water in intimate contact are in equilibrium only at 32 F (degrees Fahrenheit). However, it is not sufficient to use a mixture of ice and water if they are not in intimate contact, for in that case they may not be in equilibrium. Some of the water in a bath containing only chunks of ice may have a temperature several degrees above 32 F. An ice and water bath for use as a reference temperature should be composed of crushed ice having all the interstices filled with water but with no excess water present.

There are available now, for making thermocouple readings, potentiometers in which a compensating device is installed that makes it unnecessary to use an outside reference temperature such as an ice bath. In such instruments the compensating device consists of a wire having a resistance which changes with change in temperature. This wire is near the reference junction of the thermocouple, and to compensate correctly should be at the same temperature as the junction. If the two temperatures are not equal, the results will be in error. It is therefore necessary that such a potentiometer be allowed to remain at a constant temperature for some time before taking a reading, in order to allow all parts to come to equilibrium.

Constantan wire, which is commonly used for thermocouples, is an alloy and various samples of it are liable to vary widely in thermoelectric power. Each time a new supply is obtained a new calibration for converting readings to temperature is necessary. Calibration data published in tables cannot be used directly for converting readings taken with copper-constantan thermocouples unless the wire actually used has been found to agree with the tables. This variation between samples of wire is too large to be considered negligible, except when very rough approximations of temperature are sufficient. On account of the variation, a potentiometer graduated in degrees instead of electromotive force should not be used, except with thermocouple wire of the same characteristics as that for which the potentiometer was designed.

Presented before the Farm Structures Division of the American Society of Agricultural Engineers at Chicago, Ill., December 1, 1936.

Author: Agricultural engineer, Bureau of Agricultural Engineering, U. S. Department of Agriculture. Mem. ASAE.

Since the temperature-sensitive part of a thermocouple, the point where the two wires are joined together, is relatively small, and therefore has small surface of contact with the material of which the temperature is being measured, it is necessary to make sure that very little heat travels down to the junction along the wires forming the thermocouple. In measuring surface temperatures of wood, for example, this is done by making a slit several inches long along the grain of the wood and imbedding a considerable length of the wires as well as the junction itself. This is specially important if conditions are such that the lead wires are exposed to temperatures different than that of the surface.

For measuring surface temperatures of material in which thermocouples cannot be buried, such as metal or glass, ordinary methods cannot be depended upon. Under such conditions, some investigators have determined the temperatures by rubbing the surfaces with samples of wax, so selected that each one will slide easily over any surface above a particular selected temperature. By using a series of such waxes the approximate surface temperature may be determined.

For measuring humidity, the wet-and-dry-bulb psychrometer and the hair hygrometer are probably used most commonly. For certain purposes these answer very well, but it is often desired to know the humidity at remote or inaccessible places or in small enclosed spaces. No entirely satisfactory means for doing this has been developed. In a fruit storage room, for example, the effect of the humidity within each package is probably more important than that between the packages or in the open space in the room. Samples of the air within the package may be withdrawn through tubes and passed over a psychrometer, but this removal of air upsets conditions and sometimes the condensation of moisture in the tubes makes such a method impossible. Various electrical means, usually depending upon changes in electric resistance of some hygroscopic material, have been tried but so far none of these has come into general use. More suitable means for measuring humidity are greatly needed in many research problems.

The USDA Forest Products Laboratory has developed an instrument for measuring the moisture content of wood. It depends upon measurement of electric resistance with a special meter. This has given good results and in some cases may be adapted for measuring humidity. A small block of wood is exposed to the atmosphere and allowed to come to moisture equilibrium, then a reading of the moisture content is made.

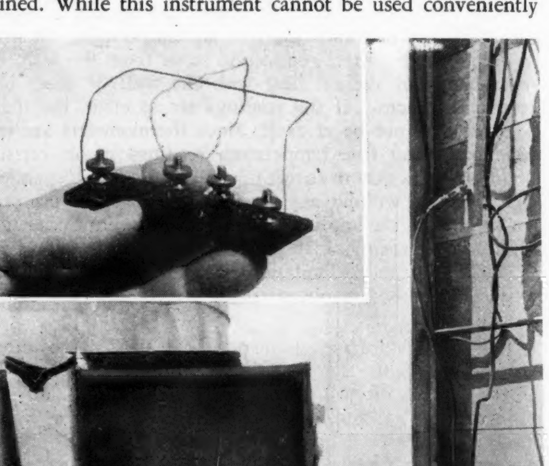
In conducting experiments in storage rooms or in living quarters it is often desirable to know the velocity of air movement in connection with temperature studies. Mechanical anemometers are useful in such cases if the velocities are high enough to be read. Often, however, the velocities are too low to actuate a mechanical anemometer and a katathermometer may be used. This is an alcohol thermometer with a large bulb. The bulb is heated prior to each reading and its rate of cooling is observed, using a stop watch. The time required for cooling through a specified range is then converted to velocity in feet per minute by a calibration chart or table.

Electric anemometers, with which the rate of heat loss from a hot wire is measured and converted to air velocity readings, have been used for some time in measurements of high velocities. In these instruments the electric resistance of the heated wire is used as a measure of the wire temperature, which is in turn related to air velocity. The electric resistance type however, is not readily adaptable to measurement of low velocities such as are ordinarily encountered in structures experiments.

The Bureau of Agricultural Engineering has developed a thermocouple anemometer which has proven useful in measuring velocities down to 6 fpm (feet per minute). It is a single thermocouple, one junction of which is wrapped with a heating coil and both junctions are exposed to the air of which the velocity is to be measured. With a measured amount of current from two dry cells supplied to the heating coil, a reading of the electromotive force of the thermocouple can be translated directly to air velocity. This instrument is adapted not only to reading very low velocities but also, because of its type and small size, to use in places not ordinarily accessible. Since the length of lead wires does not influence the readings, the observer may be stationed outside the room while obtaining readings inside and thus avoid influencing the air currents by his presence. So far, this instrument is calibrated for measuring horizontal velocities only, but preparation is being made to enable calibration in upward or downward currents.

This instrument has been used in loaded refrigerator cars, in fruit and vegetable storage rooms, in farmhouse investigations, and in grain storage bins. An attempt is being made to adapt it for use in extremely low velocities such as exist in grain bins without forced ventilation.

The Thomas meter is a useful type of anemometer for calibrating other instruments or for laboratory use. In this device air passes through a heated grid and absorbs heat which raises its temperature. The amount of heat supplied and the resulting temperature rise are measured. From the known specific heat of air, the quantity of air passing through the grid can be calculated; and then from the cross-sectional area of the duct, the velocity can be determined. While this instrument cannot be used conveniently



POTENTIOMETER FOR READING THERMOCOUPLE TEMPERATURES. (INSET) THERMOCOUPLE ANEMOMETER FOR MEASURING VERY SLOW AIR MOVEMENT

for measuring convection currents in unconfined spaces, it furnishes an excellent standard against which to check the performance of other instruments.

Another anemometer of comparatively recent development, which shows the velocity of an air stream by a pointer moving over a dial, indicates velocities down to 20 fpm.

FACTORS AND THEIR INTERRELATIONSHIPS IN DETERMINING CONDITIONS FOR HUMAN COMFORT

In problems of human comfort, the four factors of dry-bulb temperature, humidity, air movement, and effects of radiation must all be considered. The conception of effective temperature has been used to designate the combined effect of two of these, dry-bulb temperature and humidity, with some recognition of the effect of air movement. Considerable investigational work has been done to evaluate the relative parts played by each of these factors on effective temperature. Charts showing the approximate relation of comfort to various combinations of dry-bulb temperature and humidity have been published.

The effect of radiant heat on comfort is very hard to evaluate. The globe thermometer has been devised to give a resultant effect of the factors air temperatures, air velocity, and direct radiation. This device is a hollow sphere usually several inches in diameter and usually colored black, having a thermometer mounted in its center. The temperature of the thermometer is influenced by all three of these factors, but it is hard to define the meaning of the resultant thermometer reading.

In a further attempt to evaluate the various effects of air temperature, air movement, and radiation, instruments more nearly approximating the human body are being developed by several investigators. These depend upon measurement of rate of heat loss from a body at a higher temperature than its environment. The surface of a cylinder is maintained at a temperature approximating that of the clothing and skin of a man, and the amount of heat lost per unit area is measured. An alternative plan is to maintain a constant supply of heat, and measure the resultant surface temperature. The instrument is calibrated in terms of equivalent temperature. If it is exposed in a room of constant temperature in which all the surrounding walls are at the same temperature and in which there is very little air movement—that is, in a uniform environment—the relation between instrument temperature and heat loss depends only on the room temperature. If, however, radiation effects or air movement are introduced without changing the air temperature, the relation between instrument temperature and heat loss will be changed and the equivalent temperature under such conditions is defined as the temperature of a uniform environment which would have given the same readings on the instrument.

In actual use the surface temperature of this instrument may be arbitrarily set to the estimated skin and clothing temperature of a man, or the quantity of heat generated per square foot of area may be arbitrarily set to equal estimates of the heat generated by a man. While it is impossible to estimate the exact temperatures and heat losses that result in maximum comfort, such an instrument furnishes some measure of discomfort to be expected in poorly heated rooms. The effect of humidity on comfort is not included in the indications of this instrument, but it appears to be the best means available for measuring the total effect of the other three factors.

The equivalent temperature arrived at from readings of this instrument should not be confused with effective temperature based on relative humidity. The equivalent temperature indicates the combined effects of dry-bulb temperature, air movement, and radiation, omitting the humidity factor. The effective temperature indicates the combined effects of dry-bulb temperature and humidity, omitting the effect of radiation and largely ignoring the effect of air velocity. It is to be hoped that a more general index of comfort than either of these will eventually be developed.

In studying temperature effects it is often desirable to know the amount of heat received from the sun or the amount of solar heat absorbed by a wall of a building. If the rise in surface temperature caused by sunshine is measured and the thermal conductivity of the wall is known, a simple calculation will show the amount of solar heat penetrating the wall. This will be only a portion of the radiant heat received from the sun, because part is reflected by the surface and part is carried away by the air in contact with the surface. An instrument for measuring solar radiation may be used if necessary. The U. S. Weather Bureau uses such an instrument in several of its stations, and records from each of these are published. However, there are still large areas of the country in which no such records are available.

The pyrheliometer used by the Weather Bureau gives a measure of total sky and solar radiation falling on a unit area of horizontal surface. Such readings can be reduced to intensity of radiation on any wall if the orientation of the wall and angles of the sun are known. The use of such pyrheliometer readings for estimating radiation intensity on surfaces other than horizontal is not exact, because these readings represent not only radiation direct from the sun but also diffused radiation from all directions, and the calculations must be made as though all the radiation were coming direct from the sun.

In some cases, laborious computations for finding sun intensity on variously positioned surfaces can be avoided by measuring the area of shade cast on level ground by the surface. The product of the shade area times the intensity on a unit area as measured by the pyrheliometer gives the total amount of heat falling on the surface casting the shade. A further simplification may be accomplished by erecting a small mast to cast a shadow on a suitably graduated scale. The scale is so graduated that a reading of the position of the shadow of the mast multiplied by the pyrheliometer readings at the same time gives directly the amount or intensity of radiation falling on a given wall or roof surface.

The instruments that have been described herein comprise a very incomplete list of those available for farm structures research. Of all the great number that may be used in such work, each has certain characteristics that require the user to exercise some degree of judgment if he is to get dependable results. Most of these instruments may be affected by a number of conditions besides that which is being studied, and the operator must be able to judge what outside influences are likely to be important, in order that he may do what is possible to eliminate or reduce their effects. There is a general tendency to rely too much on the instruments themselves, and too little on their intelligent use. Directions for using most of the instruments are given in detail that may be followed exactly, yet seldom are sufficiently complete to assure correct results in the hands of an operator who lacks familiarity with the principle on which the device operates and with the effects of various external conditions. The limitations inherent in each instrument must be recognized, and the conditions implied by these limitations must govern its use, if the data obtained with it are to be dependable.

The Agricultural Engineer as a Farm Manager

By L. G. Heimpel

I SHOULD like to start this discussion with the findings of Theo. Brown's paper, entitled "How Farm Machinery Creates Employment."[1] It is refreshing to note that practically all agricultural progress, not only on the American continent but throughout the world, dates back to the day when agriculture in America commenced to be mechanized. Certainly it is not too much to say that our whole industrial system as we know it today dates back to the time when, due to the application of the grain binder, we first obtained cheap food. Once the danger of famine is out of the way, it seems that the number of ways in which man's living requirements can increase is limitless. It would be a good thing for all agricultural engineers to repeatedly refresh their memories with these facts by reading Mr. Brown's paper.

Management in any industry may be defined as the application of the findings of scientists to that industry. This is exactly what management consists of in nonagricultural industries. It is also what it should consist of in agriculture. After fifteen years of experience in the field of agricultural engineering and having been somewhat of a student of agricultural economics, I have come to the conclusion that while an agricultural economist does not need to be an agricultural engineer, it is absolutely essential that, if he is to remain on solid ground, the agricultural engineer must be more or less of an economist.

The economist in agriculture is trained to make surveys of the industry, to gather information as to the economic condition of the farmer and to analyze this information so that it is possible to draw reliable conclusions as to the economic conditions of the farmers in question. Farm management consists very largely of the application of the economist's findings and of organizing the productive factors of farms in such a way as to utilize not only the economist's findings but also the best methods of production, as advised by the various specialists in our colleges and experimental stations.

The agricultural economist looks at agriculture as a whole. He is one of the few men who must not allow himself to be tied to any of the production specialties. The agricultural engineer is in the same position. He must be the mechanical consultant of the orchardist, as well as of the poultryman or the dairyman.

The agricultural engineer must be familiar with the mechanical and structural requirements of any branch of agricultural production. Next, he must be an authority on soil improvement practices, particularly drainage, terracing, and tillage. He must be familiar with and an authority on all kinds of agricultural equipment. Because of this wide acquaintance with all branches of agricultural production, no one should be better fitted for applying to the farm the findings of other specialists in agriculture.

The agricultural engineer, however, has not paid a great deal of attention to this phase of agriculture. It seems to me that he cannot afford longer to neglect the necessity of studying farm management as part of this work. As a matter of fact, recent criticisms which I have heard of agricultural engineers refer particularly to the fact that the engineer is inclined to advise mechanization without sufficient regard for economic considerations involved.

The agricultural engineer should be conversant with the findings of agricultural economic surveys, because these are basic to successful farm management. Wherever such surveys have been conducted, the following have been found to be basic factors of agricultural prosperity: (1) Size of business; (2) balance between the various departments of production on a farm; (3) production yields; and (4) efficiency in the use of power and labor. Many agricultural authorities do not seem to regard the importance of the above factors. One authority on agriculture recently made the statement that "agriculture has long been and in many cases still is laboring under a production complex." By this he meant that too much emphasis was laid on the necessity of producing maximum yields per acre, per cow, and per hen. Production per man is much more important though seldom considered.

We must not forget that it may be possible for a man to be a first-class livestock breeder and feeder, and yet be a failure as a farmer, because he has not enough units of production in his dairy herd to provide a gross income which will assure him of a standard of living commensurate with a happy existence, and a sufficient surplus to permit business expansion. The fact that size of business is the most important factor in agricultural prosperity does not mean that the larger the farm the better chances for profit, but it does mean that there is an optimum size of family farm for each type of farming, which should be taken into consideration by every young man planning to start farming and by every farmer wishing to improve his business. There are many methods of measuring size of business, but the best one is that which takes into consideration the number of productive days' work which the farm supplies to each man engaged in its operation. This is definitely a relationship between the size of the productive units of the farm and the labor force. In the labor force might also be included the power equipment and machinery force. This is particularly the agricultural engineer's field. The matter of production yields is one that has received more attention from our crops and livestock specialists than has any other phase of agriculture. There is plenty of information available which is waiting to be put into practice on almost every farm in this connection. The questions of size of business, balance between the various units and efficiency of the use of power and labor, are factors so closely interwoven that the engineer, in considering the organization of a farm, cannot consider one without at the same time including all three.

Mechanization is the greatest boon ever experienced by agriculture anywhere. It has progressed without much attention from scientists to the point where it is one of the most important factors in agricultural prosperity. What it will be possible to accomplish by way of improvement in mechanization will depend largely upon the extent to which the agricultural engineer will interest himself in actual farm management.

Presented before the North Atlantic Section of the American Society of Agricultural Engineers at Skytop, Pa., October, 1936.

Author: Professor and head of the department of agricultural engineering, MacDonald College, Quebec (Can.) Mem. ASAE.

[1] AGRICULTURAL ENGINEERING for July 1934 (vol. 15, no. 7), also reprinted in booklet form.

Water Conservation Engineering in the Northern Great Plains

By L. C. Tschudy

RAINFALL in the states of South Dakota, North Dakota, Montana, and Wyoming, is very limited, ranging from an average of about 25 in maximum to about 11 in minimum. Naturally there is a lack of water throughout this area. The normal water supply is derived from pot holes, running streams, small dams, and wells. The past few years of subnormal rainfall has demonstrated a very urgent need for some type of artificial construction to develop a permanent and reliable source of water supply for individuals and livestock. Nature's sources of supply have suffered heavily during periods of minor or major drought. Streams have dried up, the water in pot holes has evaporated, and the water level of wells has dropped alarmingly. The success of agriculture in this area requires that a permanent water supply be available to individuals and to communities, as well as to livestock. One of the best known methods of developing permanent water supply artificially is the construction of water conservation dams. Water can be provided only after a complete study has been made, considering drainage area, land use, topography, storage, geology of dam site, and availability of materials.

The following procedures indicate the policy followed by the USDA Soil Conservation Service in the four states on water conservation operations. The priority of the different classes of work is (1) field operations which might include contour tillage, contour strip cropping, contour pasture furrows, terracing, or other structures which demonstrate a well-rounded conservation program, (2) stock watering reservoirs, (3) flood irrigation, and (4) water conservation dams.

This paper deals chiefly with the engineering phases of the last three subjects, that is, stock watering reservoirs, flood irrigation, and water conservation dams.

Presented before the Soil and Water Conservation Division of the American Society of Agricultural Engineers at Chicago, Ill., December 3, 1936.

Author: Regional engineer (Region 9), USDA Soil Conservation Service. Mem. ASAE.

PAULSON DAM, LOCATED NEAR PARK RIVER, NORTH DAKOTA
With rubble masonry overflow gravity section 9 ft high, this dam is for water conservation, and the storage is utilized by livestock and for individual needs

A stock watering pond or water conservation dam is designed wholly and specifically for the purpose of furnishing water at those times when it is needed. The designs must center around the plan that the storage created will be available during periods of drought. If the dam goes dry at a time when the farmer needs water for 200 head of livestock, then obviously someone has failed in designing the structure. This failure may compel the farmer to sell his entire herd of livestock. The reservoir should have a minimum depth of 8 ft. Anything less than this is likely to go dry during periods of drought. Evaporation in the states mentioned will average from 36 to 48 in. Very often soil conditions are such that there is also considerable seepage, therefore, the minimum depth of 8 ft specified above is considered safe. However, it is desirable to have more depth if economically possible. The policy for stock watering and water conservation dams in Region 9 of the Soil Conservation Service is that earth dams should not exceed 20 ft in height, rubble masonry should not exceed 10 ft to the spillway lip, and timber crib should not exceed 8 ft to the spillway lip.

A thorough investigation should be made of the potentialities of every dam before construction starts. This is imperative! This investigation should include a survey and plan outlining the drainage area, estimating the maximum flow to be taken over the spillway, a map showing the geological strata in the foundation, available construction materials, and a section of the dam with a permanent design for the spillway. When the survey and plans are completed, an estimate of results should be submitted to determine whether or not the project is economically feasible. No construction should start before this preliminary investigation has been made and it is determined that the unit costs will be economical. This applies to any of the water conservation measures planned.

Proper design for an earth dam includes a cutoff, preferably in the center, that will prevent excessive seepage of water underneath the dam through any pervious strata. The most economical type of cutoff is a clayey sand core. There is considerable variation in the amounts of sand and clay which may be combined to make up this core. It must be of such a consistency that it will pack easily and thoroughly when sprinkling is applied to the separate layers in this core material. For stock watering and small water conservation dams, a clayey material has proven satisfactory. The foundation site must be stripped of all vegetative matter. *All* tree roots must be removed before any earth is placed in the fill. There should be a drainage system installed in the downstream third of the dam. It is also very desirable to have a rock toe on the downstream side of the dam. For these small structures, back water may often occur and with this rock toe, a very desirable protection is afforded to the earth fill against back water action. The ideal section of an earth fill dam for our purpose would be that the

TYPICAL WATER CONSERVATION MEASURES IN A SEMI-ARID REGION

(Left) Bolman Dam, located near New England, North Dakota. This is an earth fill dam 14 ft high, with a rubble masonry spillway and a storage capacity of 55 acre-feet. This water conservation dam provides water for livestock and was utilized by many farmers during the drought period. (Right) Flood irrigation system located near Baker, Mont. A diversion dam and dyke is located upstream. The water enters the distribution system through plank gates and is diverted over the land to be irrigated by the distribution system. This small flood irrigation system covers 30 acres

upstream two-thirds be of very fine impervious material. The downstream third would consist of a more pervious material. The earth fill must be compacted in layers not to exceed 3 to 6 in in order that the best possible results may be obtained. Without proper compaction, water might flow through the fill and failure occur. The line of saturation through a compacted dam which results after the lake is full, would hit this porous material in the downstream third and gradually drain down to the drainage system and be taken out at the rock toe. The upstream face should be thoroughly riprapped for protection against wave action. The downstream face of the dam should be so seeded that the resulting sod will offer protection to the slopes of the dam. The spillway is the biggest source of failure in earth dams. Very careful studies must be made of the expected maximum flow. It may be necessary to alter the entire design of the dam in order that a vegetative spillway can be utilized. However, it is very necessary when a vegetative spillway is utilized to be sure that erosion will not occur and result in a gully or a new stream channel around through the spillway. Many dams have failed because individuals have expected too much of a so-called natural spillway which was never designed nor intended by nature to carry certain flood flows. In these investigations, it may be necessary to design a permanent mechanical spillway. Where field rock or quarries are available, rubble masonry can be constructed in such a manner that a permanent spillway will result. If a rubble masonry spillway is planned, the design should include drainage for waters that might collect beneath the masonry slab. By draining out this water, piping may be eliminated, and in the colder climates, drainage furnishes protection from heaving by frost action. An upstream cutoff wall should go to sufficient depth that washing will not occur beneath the slab nor around the ends. It has been found in our region that this minimum depth should be 4 ft, and very often 8 ft, for these dams, depending upon the geological strata. The downstream cutoff should extend to a depth of about 4 ft. It is well to place a 2-ft layer of riprap at the outlet of the masonry structure, thus affording some protection as the water flows at high velocities from the spillway apron. Reinforced concrete should be used where rubble masonry is not practical. Where the proposed vegetative spillway will not carry the flow without damage, it is false economy to eliminate a mechanical spillway merely because materials cost money. If all of these designs are carefully studied before construction starts and proper supervision is given following these designs, then very few failures should occur.

The rubble masonry gravity section overflow dam is designed for places in stream channels where it would be impossible to design for the maximum flow that might occur. Here again a thorough investigation and estimate must be made before construction starts. This structure is usually located in flat channels with very large drainage areas. It may be designed to carry 5,000 sec-ft, although flood records may show that 25,000 sec-ft may be the maximum flow recorded. Should such a flood occur, the stream channel would overflow its bank. The back water would be high and the overflow dam would be submerged. However, there would be a small drop between the upstream side and the downstream side in the flow, and no appreciable amount of erosion or damage would result if the wing walls were extended far enough into the bank. A general rule applied for this type of construction is that the spillway lip does not reach an elevation higher than 60 per cent of the depth of the stream channel. The cutoff wall beneath the masonry structure should be of sufficient depth to eliminate danger of seepage. It has been found imperative in rubble masonry that all rocks be cleaned with a wire brush. There is a little scale or dust on every rock. If this is not taken off, the mortar does not make a satisfactory bond with the rock, and seepage results. This seepage is not a dangerous loss of the water supply in the reservoir, but it makes the dam susceptible to damage by frost action. In freezing and thawing, some of the masonry chips off, while if it is impervious, the structure lasts considerably longer. Each stone placed in a rubble masonry structure should be immersed in mortar. The mix generally used in our region for this type of work is 1 to 3. It has been found by actual operations in the field that about 2½ to 3 sacks of cement are needed for every cubic yard of masonry in place. There will be a certain amount of uplift pressure from water that goes through or around the cutoff walls. This uplift pressure is relieved by the drainage system beneath the apron of the gravity section.

The timber crib dam is designed for the same channel requirements as the rubble masonry dam, and for the same large drainage areas. Here again the same investigations and costs must be estimated for timber crib dams before any construction starts. However, rock for rubble masonry may not be available in that community and the timber crib is designed to meet those needs. Timber crib construction actually figures out to about the same cost as rubble masonry, provided rock is available. I have observed several timber crib dams constructed in North Dakota, and one which is 40 years old is still functioning quite well. One reason why timber crib dams will last for a considerable time in our area is that rainfall is limited. There is another desirable factor in constructing a timber crib dam. The operations can be carried *(Continued on page 67)*

The Challenge of Rural Electrification to the Agricultural Engineer

By Grover C. Neff

ELECTRIC service on the farm is a new development. In fact, the whole electric utility industry is comparatively young. The census made by the National Electric Light Association in 1924 showed that of the 6,500,000 farms in this country, approximately 166,000 had electric service at the end of 1923. This is such a small per cent of the total farms of the country that we can say that farm electrification began in 1923. Since 1923 there has been carried on in this country an intensive activity which had for its purpose the bringing of electric service to the farms of the United States. The public utilities, farm organizations, agricultural colleges and experiment stations, manufacturers of electrical and farm equipment, and many others joined forces and in a co-operative way fostered the development of rural electrification in this country on an intelligent and economical basis. The Committee on the Relation of Electricity to Agriculture was the organization which headed up this co-operative work. You men are familiar with the fine work of this committee; in fact, prominent agricultural engineers, members of the American Society of Agricultural Engineers, are members of this committee and have contributed very largely to the success of its work. Dr. E. A. White, who has been director of the Committee since it was organized, is a charter member and past-president of the Society. Through this committee the fact-finding work done by experiment stations and agricultural colleges is given proper publicity, and valuable information on how to use electricity on the farm is placed in the hands of the proper people. As a result, the farmers of this country who are now getting electric service have been materially helped in its wise and practical use.

This activity produced results as is demonstrated by the fact that, in the years immediately preceding the depression, the public utilities of this country were extending electric service to approximately 100,000 new farm customers a year, and at the beginning of the depression were supplying approximately 750,000 farms with electric service. The coming of the depression brought about a condition wherein the utilities were not able to finance the building of new lines, and farmers were not able to wire their homes or buy appliances. Therefore, very few new farms were electrified from the beginning of the depression to the end of 1934.

However, with the passing of the depression the public utilities of this country again started building farm lines, and in 1935 it is estimated that 40,000 new farms were electrified. In 1936 the public utilities have again reached the stride they attained prior to the depression, and will bring service to approximately 100,000 new farms, so today nearly 1,000,000 farms are receiving electric service from the public utilities of this country.

About two years ago the Congress of the United States provided for certain funds which were to be loaned by the federal government to various agencies for the purpose of building electric farm lines. To administer this activity the Rural Electrification Administration was set up. This organization has become very active in promoting the building of farm electric lines to bring service to farmers not previously receiving it. With but few exceptions the loans have been to farmer co-operatives who propose to build their own lines and supply their own service, usually by purchasing the energy required from an existing generating plant. While, to date, only a few farms are actually receiving electric service from the lines owned and operated by these co-operatives, the number will undoubtedly materially increase during the next few years. Without question, the REA activity and the great amount of publicity which it has sent out, has increased the desire of farmers for electric service. While this is desirable from many angles, it also tends to complicate and intensify the problems connected

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ELECTRIC POWER WILL BRING ABOUT GREAT CHANGES IN FARM EQUIPMENT AND IN THE METHOD OF CARRYING ON FARM WORK. AGRICULTURAL ENGINEERS MAY WELL TAKE THE LEAD IN SEEING THAT THESE CHANGES ARE MADE INTELLIGENTLY AND EFFICIENTLY

THE DAIRY IS AN IMPORTANT PLACE FOR ENGINEERING CONTROL OF CONDITIONS INFLUENCING QUALITY OF PRODUCT

with bringing electric service to the farm on an intelligent and economical basis.

Electric service from public utilities brings a new form of power to the farm. This fact must be recognized if we are to avoid many costly mistakes, and it seems to me that the agricultural engineers of the country can help very materially in the sound guidance of this development. I refer to the things the farmer will do in his efforts to use electric service, the money he will spend for wiring and for appliances, the kind of equipment he will buy, and how he will use it. All of these are important factors in the successful economic use of electric service on the farm. I know of no group better qualified and better trained to guide the farmer in spending his money wisely and for the right things, than the agricultural engineers of the United States.

Whenever a new and different form of power has been brought to and accepted by any industry, it has revolutionized that industry. When steam engine power was applied to the shipping industry it brought fundamental changes. It changed the shape of boats. It changed the type of people who manned the boats. It changed the methods of carrying on the shipping business.

When steam power was applied to transportation on land it completely transformed that industry. The stage coach had to give way to the railroad. The people who operated the railroad train had to have different training from those who handled the stage coach and wagon. The introduction of steam power to transportation on land certainly radically changed that industry. Transportation on land was again revolutionized with the coming of internal combustion power, which made possible the automobile and the truck.

With the coming of steam power great factories were established over the country with their many line shafts, belts, and pulleys. When electric power was brought to the factories, they went through another transformation. The line shafts, belts, and pulleys disappeared, and individual motors took their places.

All through our history the introduction and acceptance of new forms of power have literally revolutionized our industries. It seems to me, therefore, that we will all agree that the bringing of electric power to the farms of this country will bring about great changes in farm equipment and in the method of carrying on farm work. Therefore, it is the job of somebody to see that these changes are made intelligently and efficiently, if the best results are to be obtained. While these changes will somewhat involve every agricultural activity, I believe the agricultural engineer is the one who must take the lead. Since the changes are caused by the introduction of a new power which affects the mechanical devices on the farm, the agricultural engineer should be more interested and a better guide in these changes than any other single specialist in the farm field.

Anyone who has given serious thought and attention to rural electrification knows that one of the biggest problems in connection with this development, is to determine the proper methods of applying electric service to farm operations. Rural electrification should mean electricity at work on the farm, doing the tasks the farmer has to perform, in a better or more economical way than these tasks have been done before. The application of electric service to farm operations is the unsolved problem of rural electrification. It will be most unfortunate if the farmers of this country to whom electric service is brought, spend a large amount of money for things that will not give them the benefits to which they are entitled. Such things will have to be discarded in the near future, or replaced by better and more efficient appliances. This danger has always been present in the development of rural electrification, but now becomes more of a hazard because of the building and operating of lines by farm co-operatives.

SOME THINGS AGRICULTURAL ENGINEERS CAN DO

1 *See that electrical wiring on the farm is adequate, well laid out, and safe.* Nothing is more unsatisfactory or expensive to the farmer than an inadequate wiring job. One of the most important things in rural electrification is to get adequate, well-planned, safe, and economical installations of wiring. This will not occur in many cases unless something is done to impress upon the farmer the value and necessity of an adequate wiring job. No one is better fitted to do this than you.

2 *Develop farm machinery suitable for electric drive.* Most of the farm machinery built today has been designed for horse power, tractor power, and steam and gas engine power. Very little of it has been designed to take full advantage of electric power. Electric power lends itself better than any other power to automatic control. In most cases,

no attendant is needed. This opens up a big field for automatic equipment which can be run twenty-four hours a day, if necessary. It offers the advantage of reducing the size of the appliances, which reduces their cost to the farmer, and the cost of electric service to him as well.

It seems to me that the agricultural engineers of this country should demand, fight for, and help develop a complete line of farm machinery built especially to take full advantage of electric power. Unless this is done, electric power will be used to operate equipment designed for some other kind of power, and the result will be about the same as when the first automobile manufacturer put a gasoline engine in a buggy and called it an automobile. The equipment must be designed to fit the new kind of power before real efficiency is obtained and the full measure and advantage of the new power realized.

3 *Bring about the co-operation of farm experts.* Electric power will bring many changes to agriculture, in all its varied phases. It will affect farm management as well as the present methods of carrying on farm work. If, therefore, maximum advantages are to be obtained, it will be necessary to enlist the co-operation and help of all men and women who are specializing in some particular phase of farm activity.

Bringing electric power to the farm will in many cases make possible either savings in the cost of operating the farm or improved production, if certain changes can be made in the present methods of farming. Many of the changes will be in farm practices entirely outside of the field of the agricultural engineer. However, as these changes are made possible, because of the availability of a new form of power, the agricultural engineer should take the lead in soliciting the help and co-operation of all agricultural leaders to the end that the best overall results may be obtained.

4 *Help develop, promote, and establish courses in schools and colleges.* As electric power becomes available to more and more farms, it is necessary that proper courses be offered in our schools and colleges so that young people who expect to operate electrified farms may learn how to operate electric equipment and appliances in an efficient manner. Some colleges and schools are beginning to set up these courses, but the agricultural engineer can do a lot toward improving these courses, and seeing to it that they are made more wide-spread and more easily available to the farm people who wish to take them.

5 *Support the CREA.* The Committee on the Relation of Electricity to Agriculture brings together representatives of the several groups interested in rural electrification. It is important that these representatives meet and frankly discuss their problems and exchange ideas if rural electrification is to be developed on an intelligent and economical basis.

The CREA also renders valuable help when it collects worth-while data on work done by experiment stations, agricultural colleges, public utility people, or any one else and gives such information wide publicity to the interested parties in the best position to pass it on to the farm users of electric service.

These and many other services rendered by the CREA entitle it to your continued support. It is more valuable today than when it was first organized, as there is today more haphazard and wishful thinking about rural electrification than ever before.

There is really nothing new in what I have suggested. I have recommended exactly what has occurred in the past when a new form of power has been brought to an industry. In the past, however, the things I have recommended were done for the most part after costly mistakes had been made, and huge amounts of money wasted. If we can convince ourselves today that all of these things will eventually be done, why not do them now? That would avoid some of the expensive errors of floundering around that are sure to occur unless some leadership is provided. That leadership must be furnished by men who have the imagination and the proper training to know what to do about it. The agricultural engineer is the man best trained to furnish this leadership. I believe the agricultural engineer is on the spot. You have it in your power to pilot rural electrification over many dangerous shoals. If you do this well, the American farmer will owe you a great deal, the utilities of this country will benefit, and the people generally will profit thereby. Your responsibility in this new development is large, but I am sure that you will measure up to it.

Water Conservation Engineering in the Northern Great Plains

(Continued from page 64)

on in the winter time when it is rather difficult to construct masonry.

Flood irrigation has an excellent field in the four states within Region 9. This type of construction might be pictured as a diversion dam across a stream channel with fairly level bench land. The diversion dam has a dyke which may follow a contour or a very slight grade leading away from the stream channel for a distance of from 500 to 2,000 ft. This diversion dyke has outlets through it so that water may pass through and spread over the bench land between the dyke and the old stream channel. A small irrigation distribution system consisting of low dykes is installed between these limits. The openings in the main irrigation ditch, consisting of a dyke and channel, release enough water to irrigate that patch of land below. The openings in the irrigation ditch have a plank headgate constructed somewhat similarly to those used on irrigation projects. Generally, this small flood irrigation system does not irrigate more than 5 to 50 acres. The rancher with winter range has suffered greatly from lack of feed for the past few years. As a result, his range has been harmed greatly. By utilizing flood waters in flood irrigation he can raise a garden and enough alfalfa to furnish him a security for the type of agriculture he plans. Where water conservation dams have been constructed, farmers may buy a pump and develop a small irrigation system for domestic and livestock use. All of this water stored by dams or by flood irrigation is water conserved, and if not developed would be wasted and finally flow out to the Gulf of Mexico or flow north into Canada.

Some ranchers have sold their entire herds the past year, and others, because of drought conditions, have been unable to harvest any crops. The construction of water conservation dams by Soil Conservation Service in the Northern Great Plains states will demonstrate the practical application of this work to the people. It not only benefits the areas, but is a measure of flood and erosion control. The engineer must investigate, design, and direct construction, correlating the dams in a full conservation program, thereby molding economical and feasible demonstrations.

Electrification of a Fruit Farm

By Truman E. Hienton

ELECTRIC power is being employed to drive water pumps, spray plants, fruit washers, fruit sizers, cider presses, fans and refrigeration machinery in the fruit storage, and to a limited extent for irrigation. Electric lighting is installed in the storage house and other buildings and is attracting attention to its possibility in insect control. Electric heaters offer some assistance in problems of spray-residue removal. The extent to which electric service is being employed is reflected in the energy consumption of a 260-acre Indiana apple orchard in 1935, 74,442 kwh (kilowatt-hours). Another apple orchard, of approximately equal size, consumed more than 61,000 kwh in the first year after electric service was obtained.

Water Pumping. Water supply is of prime importance to the fruit grower. Reliable pumping units and power supply are necessary to furnish the amounts needed for spraying, washing, and the refrigeration machine. Records were obtained through use of a check meter, of the energy consumption of a 2-hp motor operating the water pump on one of the Indiana orchards mentioned for a period of three years. The average annual consumption during this period was 1767 kwh, or nearly 150 kwh per month. Water furnished by the pump was used for spraying, cooling the condenser of the refrigeration machine, and miscellaneous uses, but not for a fruit washer or household purposes. The average amount of spray material applied annually during the three-year period was 381,350 gal, according to records of the operation of the spray plant. A year later 842,350 gal of spray material were supplied by the same spray plant, which would naturally require more energy for pumping water. Further demand for water would have been occasioned by the use of a fruit washer.

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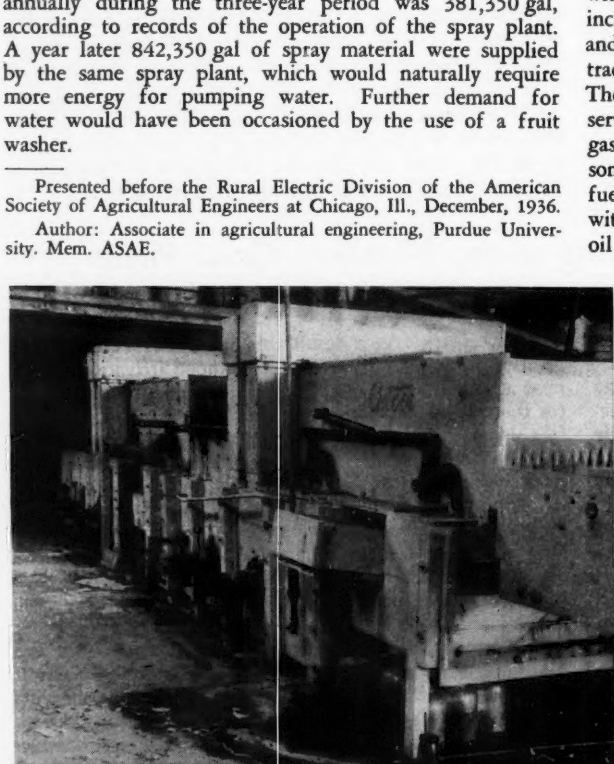
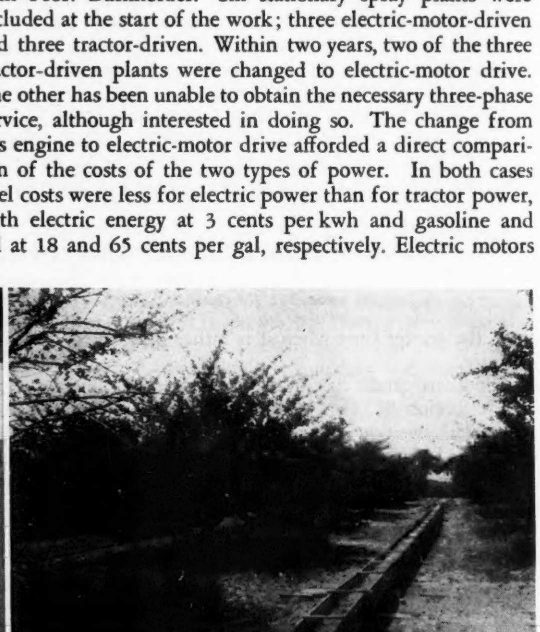
Spraying with Stationary Plant. Due to the need for a comparison of the latest type of portable spraying equipment with stationary machines, both types were installed for investigation in an 80-acre orchard on one of the experimental substation farms of Purdue University. These installations were made under the direction of C. L. Burkholder of the horticultural department in 1930, and their operation supervised by him since that time. Fifty acres of the orchard were sprayed from the stationary spray plant and thirty with the portable machine. A 10-hp electric motor is used to drive the stationary plant.

The following is quoted from a recent report by Prof. Burkholder on the results of this study: "A summary of the three best years of the work shows a cost of 59 cents per 100 gal of spray materials applied through the stationary spray plant and 74 cents per 100 gal when the portable sprayer was used.

"Based on an average application of 130,000 gal per year and at a saving of 21 cents per 100 gal, the entire cost of the present stationary plant could be paid for in less than seven years. Speed of coverage and ease of spraying in wet seasons are added advantages for the stationary plant. Lack of thorough coverage in the tops of tall trees is a serious disadvantage."

A study of power costs for operating stationary spray plants was initiated in 1929 by the author in cooperation with Prof. Burkholder. Six stationary spray plants were included at the start of the work; three electric-motor-driven and three tractor-driven. Within two years, two of the three tractor-driven plants were changed to electric-motor drive. The other has been unable to obtain the necessary three-phase service, although interested in doing so. The change from gas engine to electric-motor drive afforded a direct comparison of the costs of the two types of power. In both cases fuel costs were less for electric power than for tractor power, with electric energy at 3 cents per kwh and gasoline and oil at 18 and 65 cents per gal, respectively. Electric motors





(LEFT) TWO MOTOR-DRIVEN FRUIT WASHERS OPERATED IN TANDEM BY A 10 AND A 5-HP MOTOR, NEAR VINCENNES, INDIANA. (ABOVE) AN OHIO ORCHARD IRRIGATED BY PIPING WATER TO THE HIGHEST GROUND LEVEL, RUNNING IT THROUGH WOODEN TROUGHS TO DISTRIBUTION POINTS; AND IN FURROWS TO THE TREES

in use on spray plants in Indiana at the present time vary in size from 3 hp to a total of 55 hp on one unit.

Fruit Washing.. Removal of lead and arsenical residues from apples has become a major problem in the harvesting and marketing of the fruit crop in many locations. Enforcement of state and federal regulations on the allowable lead and arsenical residues has led to the development of various equipment for the removal of material in excess of the prescribed tolerances, lead 0.018 grain and arsenic 0.01 grain per pound of fruit.

Washers have proven most effective for removal of heavy residues and development has been greatest in this field. Machines have been developed by commercial manufacturers, and plans for homemade machines have been developed by agricultural engineers at the state colleges in Washington and Oregon.

Washers in use today may be classified as of the following types: flood, underbrush, underbrush-flood, and flotation. Power requirements of the different types vary with the size of the unit, but that of the flood type is the greatest. Newer types of washers which are being built now require power units of less capacity than the earlier types. Motors required will vary from 1.5 to 10 hp.

Indiana tests conducted from 1931 to 1933 with an underbrush washer having a capacity of 55 bu per hour and driven by a 3-hp motor, varied from 0.84 to 1.57 cents per bushel for all charges excepting interest on investment. These included electric energy at 3 cents per kilowatt-hour, depreciation at 15 per cent, repairs and replacements at 2 per cent, and cost of acid and labor. Fixed charges comprised about 85 per cent of the cost and since these were charged off each year, the differences in cost per bushel were due to variations in annual crop yields. Records of costs were obtained on the operation of a Model E underbrush-flood washer and one of the flotation type, Model X. Each washer was driven by a 2-hp electric motor. Total costs for each machine were 2.0 and 0.85 cents per bushel, respectively, but only 8,900 bu were washed by the first, while 36,494 bu were handled in the second.

Heating Apple Washing Solutions. Another item of importance in the washing of apples is the occasional necessity for heating the washing solution to insure proper removal of spray residues from late varieties. Electric heaters have been found to be of some promise in Indiana during the past three years in tests conducted by horticultural and agricultural engineering investigators of the Purdue Agricultural Experiment Station.

Two 5-kw monel-metal sheathed heaters were used in 1934 in a Model E underbrush-flood washer, and also in a Model X flotation washer. Total cost for electric heating, including an annual depreciation of 25 per cent on the heaters (first cost $25.00 each), and electric energy at 2.5 cents per kilowatt-hour, was 0.25 to 0.83 cent per bushel in the first type washer and 0.28 cent per bushel for the second. A similar installation in a Model H underbrush-flood washer in 1936 with two ordinary 5-kw heaters, costing $17.75 each, used 937 kwh in washing 8,417 bu of apples. Total cost per bushel for heating was 0.38 cent. In this installation the grower was unable to reduce the residue load on the fruit to the federal tolerance with washing solution at 70 F (degrees Fahrenheit), but by heating it to temperatures ranging from 85 to 100 F, satisfactory results were secured.

The cost of using electric heaters for heating apple-washing solutions may be as low or less than that for coal-fired steam-heating installations, when the above figures are compared with those for the latter type. Figures reported in Virginia Agricultural Experiment Station Bulletin 302, March 1936, show a cost of 89.4 cents per 100 bu where 8,000 bu are washed per season, as compared to the 1936 figures, listed above for electric heat, of 38 cents. On installations where 43,000 bu were washed, using steam heat, a cost of 21.9 cents per 100 bu was reported while 28 cents per 100 bu was the cost of an electric heating installation where 36,494 bu were washed. Successful use of electric heaters will depend upon cost for electricity and use of proper heaters, either of acid-resistant metal or covered with acid-resistant paint. Ease of control and elimination of fire hazard are particular advantages which they afford. Their use, while new in central and eastern areas, is not exactly recent in the Northwest, where one utility company reported serving thirty-eight such installations in 1931.

Fruit Sizing. The labor-saving possibilities and monetary value of mechanical sizing of fruit is almost universally recognized throughout the United States. Electric motors are generally used to drive the sizer, wherever electric service is available at the packing shed. Motors required to operate the sizer alone vary from 1/4 to 1/3 hp. In larger packing houses, belts may carry fruit from the washer to the sizer or other location, reducing the amount of labor

(LEFT) ENTOMOLOGISTS OF PURDUE UNIVERSITY RECOMMEND THE USE OF AN ELECTRIC INSECT TRAP INSIDE THE FRUIT PACKING OR STORAGE HOUSE DURING THE SPRING, WHEN THEY HAVE BEEN SCREENED IN TO PREVENT ESCAPE. (RIGHT) A FRUIT PACKING AND STORAGE HOUSE NEAR ORLEANS, INDIANA, IN WHICH MORE THAN 200,000 CODLING MOTHS WERE TRAPPED IN ONE SEASON. THE COVERING IS OF MUSLIN, WHICH PREVENTS NEWLY EMERGED MOTHS ESCAPING TO NEARBY ORCHARDS (COURTESY GENERAL ELECTRIC CO.)

required in the handling of the fruit. Such combination installations may necessitate the use of a motor of 2 hp or larger to handle the sizer and the additional load of belt conveyors.

Records of electric energy consumption of a fruit sizer were kept for a period of three years at the Purdue farm near Bedford, Indiana. Nearly 38,000 bu were handled by the machine during the test period with an average consumption of 0.87 kwh per 100 bu.

Cool and Cold Storage of Fruit. Air-cooled apple storages have been successfully used by growers as an aid to orderly marketing of their fruit, where fall air temperatures make possible practical cooling of the fruit. Electric fans are used in such storages to increase the natural ventilation of the houses when desirable. Such fans have been installed vertically in a side wall of the storage room, or horizontally in the ceiling. Fans have been used experimentally to circulate air inside a storage room where ice was being used to precool the stored fruit.

Cold storage plants are proving practical at the larger orchards and are increasing in number in territory where markets may be reached by truck transportation. Two such plants were installed in Indiana in 1931 and two additional ones in 1935. Of the first two plants installed in Indiana, one was of 40,000-bu capacity and the second originally of 18,000-bu capacity, but enlarged to 43,000-bu in 1935. The plants installed in 1935 were of 15,000 and 55,000-bu capacities.

The larger plant is a three-story storage, with air forced to all floors by means of a blower driven by a 10-hp electric motor. A 5-hp motor circulates the brine through a brine spray air-blast system. The 15-ton refrigeration machine is driven by a 30-hp electric motor. The original section of the second plant is cooled by a coil system using direct expansion, combined with air circulation produced by means of fans mounted at the sides of the room. The newer section is refrigerated by integral cooling units which include refrigeration coils, brine spray and blowers.

The use of cold storage equipment at the orchard offers several advantages to the grower. Fruit may be quickly cooled after harvest which reduces the rate of ripening. Fruit of number 2 grade may be held in storage until marketing conditions are more favorable to absorbing that class of fruit. Cider may be stored and kept sweet for longer periods of time than if stored at warm temperatures. The investment in such equipment may be excessive for the individual grower. This problem has been solved in several locations through formation of partnerships or cooperative fruit storage associations.

Irrigation. Orchard irrigation is normally associated with fruit growing of the far West. However, irrigation pumping installations made in Virginia and Ohio orchards during the last few years indicate the value of supplying water to supplement rainfall during dry seasons in those states.

C. E. Seitz, of Virginia Polytechnic Institute, reported the installation of some ten or more plants for irrigating orchards in Virginia during dry seasons in 1930 and 1932. An Ohio orchardist also installed a pumping plant in 1932 and reported a yield of 290 bu of apples from an unirrigated area and 360 bu from the irrigated block, an increase of nearly 25 per cent.

Two northern Ohio fruit growers, east of Cleveland, have made permanent installations for irrigating their orchards. It is reported that one grower ran check plots for several years on a small orchard before making the present installation which covers 190 acres. This orchardist reported an increase in apple size of 1/4-in diameter in five years out of six. The irrigation pumping plant includes a pump, which delivers 425 gpm at an average head of 176 ft, driven by a 25-hp motor. Water is delivered by the pump to a high spot in the orchard and flows by gravity in flumes to various locations, from which it is applied by the furrow method. The second grower irrigates 125 acres, using a pumping installation driven by a 30-hp motor. Water is distributed to the trees by canvas hose in which eyelets have been fastened.

The cider press enables the fruit grower to convert very small apples, and others from which little return might be realized, into a more valuable product. Equipment of this type which is of recent manufacture is usually driven electrically. A 1.5-hp motor is required for a size suitable to the needs of the grower with large acreage.

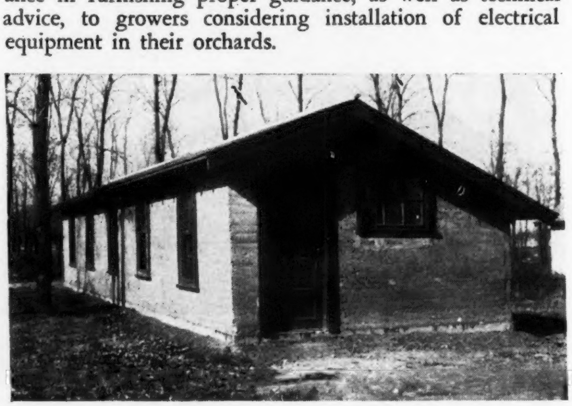
Research on control of codling moths by electric traps has been conducted in California, New York, and Indiana by entomologists of the agricultural experiment stations working cooperatively with agricultural engineers. A recommendation is made by the entomology department of Purdue University that the use of such a trap is advisable at night in packing houses which are enclosed in the spring to prevent the escape of moths to the orchard. An ordinary 100-watt Mazda C lamp is suggested for use in the trap.

Reports of research work in California and Indiana on precooling of fruits before shipment have been published in AGRICULTURAL ENGINEERING and bulletins from the California Agricultural Experiment Station. The use of such precooling equipment by fruit growers is well established in California and likely to increase in other areas where certain fruits are shipped in carlots during warm weather.

The application of many of the uses of electricity in additional orchards will depend upon the local conditions. Agricultural engineers with educational institutions, power companies, and manufacturers can be of considerable assistance in furnishing proper guidance, as well as technical advice, to growers considering installation of electrical equipment in their orchards.

A STATIONARY BROODER HOUSE WITH RAMMED EARTH WALLS

This house was built by the department of agricultural engineering at the South Dakota State College at Brookings, in the spring of 1936. The walls are 14 in thick and are rammed with a soil that was made highly favorable by the addition of the correct amount of sand. Sand was mixed with the soil according to the results of a recently developed test which accurately identifies the favorability of any soil for earth construction. The surface of these earth walls will be left unprotected for 100 years and the weathering action will be recorded. The soil used in this wall contains 19 per cent total clay colloids. Approximately 78 per cent of it is sand and gravel.—Courtesy of R. L. Patty.



Air Conditioning Applications to Farm Buildings

By S. A. Witzel

THE agricultural engineer has a distinct place in the new field of air conditioning. His problems may vary from the complete air conditioning of farm homes to the seasonal air conditioning of other farm structures such as storage buildings, poultry houses, barns, and hog houses. Year-round air conditioning with temperature and humidity control will require heating equipment, humidifiers, filters, forced air circulation, and cooling equipment; while other farm structures air conditioned for temperature and moisture control for shorter periods may involve only the heating equipment or the refrigeration equipment, together with equipment for humidity control, and with or without forced-air circulation and air filters or washers.

Temperature and humidity control are phases of air conditioning destined to play an ever-growing part in modern agriculture. Some successful and profitable applications have been made on Wisconsin farms during the past three years. The following is a brief description of these projects.

Apple Storage. In the summer of 1931 an orchard owner in western Wisconsin built an apple storage cellar, 30x50 ft, in a hill next to the packing shed. Apples were picked and placed in this common storage cellar until they could be packed and sent to market. A slatted floor was provided. The earth beneath was saturated or covered with water. This provided a high humidity, essential to prevent shrinkage. A temperature of from 55 to 65 F (degrees Fahrenheit) was maintained. The storage cellar served a useful purpose in extending the packing season somewhat.

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Author: Assistant professor and extension agricultural engineer, University of Wisconsin. Mem. ASAE.

(LEFT) AUTOMOTIVE RADIATOR COOLER INSTALLED IN APPLE STORAGE. (RIGHT) COOLING TOWER FOR WATER RECIRCULATED IN APPLE STORAGE COOLING SYSTEM USING RADIATORS SHOWN AT LEFT

The apple market frequently fluctuates quite rapidly, and even a few days after the picking of some varieties is over, the market may show a decided improvement. When apples can be held for one or several weeks and their quality maintained, a much higher market value may frequently be realized. With this late market in mind, a cooling system was installed in 1935.

The cooling system consisted of a compressor and cooling-water pump driven by electric motors. A large supply of cooling water was not available except at prohibitive cost, so a cooling tower was erected and the same cooling water is used throughout the season. The four cooling units in the storage cellar have automotive type radiators and electrically operated fans to force air through them. Piping for two cooling units was also provided in the basement of the basket and ladder storage house adjoining the large storage cellar and packing shed.

Storage capacity of the large cellar is estimated at 5,000 bu of apples in baskets, and the small adjoining basement will hold approximately 2,000 bu.

Because of the drying effect of air in rapid motion, there was some doubt as to the effect of the fan-operated unit coolers on the fruit. However, the slatted floor and moist earth beneath provided sufficient moisture for satisfactory humidity conditions. The cellar was not insulated in the 1935 season, and while satisfactory storage temperatures were maintained, the electric bill was high. Meter tests showed the meter to be unreliable, so the exact energy requirements are not known. Preliminary estimates of electric charges for this season indicate reasonable operating costs. This year two-inch cork board, set in hot asphalt, was applied to the exposed walls. The same type of insulation will be applied to the ceiling.

Temperature was held at 35 to 40 F, and humidity at 75 to 80 per cent this past season. Temporary storage of apples occurred after each variety was picked during the harvesting season. The storage period varied from a few days to six weeks. In the case of McIntosh, seven carloads went into storage when the price was low, due to heavy marketing of this variety. At the end of from five to six weeks these apples were sold at an advance of from 35 to 40 cents per bushel in market price. This refrigerated and humidified farm storage cellar has been a financial success and has resulted in placing high-quality apples on the market long after the orchard supply of that particular variety had been exhausted.

Two-story Poultry House. On a general dairy and livestock farm in central Wisconsin, a single-story, shed-roof poultry house, 14x50 ft, was remodeled into a two-story 26x70-ft house in the summer of 1935. The first floor con-

(LEFT) THOROUGH INSULATION, A SIMPLE HOT-AIR FURNACE, TWO OUTTAKE FLUES, AND WINDOWS THAT OPEN EASILY ARE THE MOST IMPORTANT FEATURES OF THIS TWO-STORY POULTRY HOUSE. (RIGHT) INTERIOR VIEW, SECOND FLOOR. UNIFORM TEMPERATURE, GOOD LIGHTING AND CONTROLLED HUMIDITY ARE PROVIDED

sists of two pens 30 ft long, with a feed room 10 ft wide in the center. Under the rear 16 ft of this feed room a basement or furnace room was provided. A good chimney was built from this room up through the center of the house. The second floor has two pens, one 30 ft long and the other 40 ft long. On the first floor, the stairway to the basement and up to the second floor was located in the feed room.

Insulation consisted of a 6-in pack of dry sawdust in all side walls and 8 in of the same material in the ceiling of the second floor. The insulation pack is protected from moisture by the following wall construction: Outside, a good grade of waterproof building paper and drop siding were used, while on the inside of studding and on the ceiling of the second floor this same grade of waterproof paper and matched lumber were used. Some authorities question this type of wall construction, but we have used it in straw-loft poultry houses for nearly 20 yr with excellent results.

Ventilation is provided in summer by opening windows. The top sash is hinged at the top and swings in to admit direct sunlight on the floor, while the lower sash tips in at the top or may be lifted out. Netting on the outside keeps the birds in. The ventilation in winter is a part of an air conditioning arrangement. A hot-air furnace with a fire pot 26 in in diameter was set up in the basement and provided with one hot-air riser to each floor, with damper controls. Cold-air return is by way of the stairs, and fresh air is either admitted directly into the furnace room from the outside, or allowed to enter through an opened window near the stairway in the feed room. On mild days, windows are opened in the poultry rooms for ventilation, direct sunlight, and temperature control. Warm air is exhausted from the east and west ends of the building and from each floor. Insulated outtake flues extend from 18 in above the floor to a point 3 ft above the ridge of the house. These outtake flues require dampers so they can be throttled down in the coldest weather.

About 850 birds were placed in this house in the fall of 1935, and from December 1 on through the winter, sixty per cent production was maintained. The flock was reduced by careful culling so 500 birds were left by the middle of June 1936. This was a good production record, considering the severe winter of 1935-36.

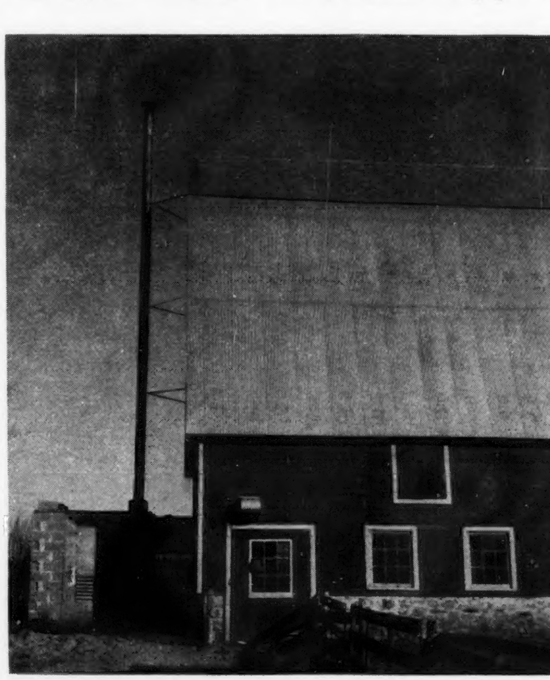
Because of thorough insulation, little fuel was required. Less than a ton of wood was used in the 1935-36 winter. Humidity was well controlled by the regulation of windows, outtake flues, and furnace heat. In fact, in the most severe weather the oat-straw litter was changed at 3 week intervals, and was not wet or matted then.

Temperature was maintained between 35 and 40 F day and night for weeks at a time, and the birds seemed to be perfectly comfortable. The furnace fire was started shortly after sundown, and was allowed to go out about the time the morning lights went on, except in the very coldest weather. After a cold spell it was frequently necessary to open the windows on a mild sunny day to prevent excessive temperature changes.

The summer temperature in this house was surprisingly low through the hottest part of the day. A temperature difference of 10 F, between outside and inside, with the inside temperature being lowest, was common. Cool south winds helped to make the house comfortable in warm weather.

This poultry house was built for $1500.00 cash, with some homegrown timber. The owner figures that his house has paid for itself during the first season. It is now filled with pullets, and they are starting off on what appears to be another profitable season. He is getting good production, and high feed prices do not bother much because he feeds mostly homegrown grains. The size of poultry house for this farm was carefully determined on the basis of farm management records, but that it another story.

Sheep Barn. Early lambs, frequently called "hot house" lambs, are preferred by many Wisconsin sheep raisers because they are usually more *(Continued on page 74)*



HAYDITE BLOCK FURNACE ROOM WITH HOT-AIR FURNACE AND ELECTRICALLY DRIVEN FAN FOR AIR CONDITIONING A LAMBING BARN. A WALL FAN AT THE OTHER END OF THE BARN EXHAUSTS USED AIR, INSURING COMPLETE VENTILATION

An Engineer's View of the Poultry Housing Problem

By F. L. Fairbanks

THERE is a poultry housing problem and one which is definitely possible of solution. Much work must be done for the final answer, but right now, December 1936, the American Society of Agricultural Engineers has among its members men who are in a position and capable of moving this problem forward to completion.

In more than one state, members of this Society have the training and the engineering data by which they can design economical poultry shelters, but when they ask the poultry scientist to set up the necessary requirements to be used as the basis of design, they can get no specific answer.

What has happened as a result? Have the agricultural engineers stayed in their offices and let the matter drift? Not at all. In two institutions that I know of agricultural engineers have approached the poultry scientists with the proposal of a cooperative research project, for the purpose of determining the optimum environmental conditions for certain types and breeds of birds.

This means that agricultural engineers recognize that it is not ventilation, or heat, or dry floors, that the poultryman wants. It is air conditioning. In other words, some of us have designed ventilation systems to fit the various types of poultry houses. These systems did ventilate successfully, but always in the cold climates the poultryman came back with the report that the ventilation was all right, that the litter was dry, but that it got too cold in the pen. The next question, of course, is the temperature the poultryman wants to maintain in the pen, and this is never answered except as an opinion. I asked a poultryman a few days ago about this, and he said that he *thought* 40 F (degrees Fahrenheit) was right. On asking him on what he based this thought, he could not tell.

A factor to be considered is the oft-repeated recommendation that poultry needs lots of air. As a result, the open-front house has been established. In recent years, layers have been housed in larger and larger flocks, and the houses have generally followed the open-front design.

It seems evident that at the present time we are attempting to eliminate the disadvantages of the open-front house by ventilation, heat, or other means, and have not thought back far enough to see where it is leading us.

The backyard flock of 100 or 200 birds probably needs little attention so far as special houses are concerned, but as soon as we put egg production on a commercial basis, the building becomes an important item. In fact, it is an egg factory, and any manufacturer would realize that the effect of weather on a manufacturing process should be eliminated. Today that means air conditioning.

There are, it seems to me, two definitions we as engineers can well bring to the attention of poultrymen, for two reasons. One is that when poultrymen understand this problem, they will get greater returns from the business. The other is that agricultural engineers need the poultry scientist's cooperation in finding the answers to questions we must ask, if we are to design an adequate shelter.

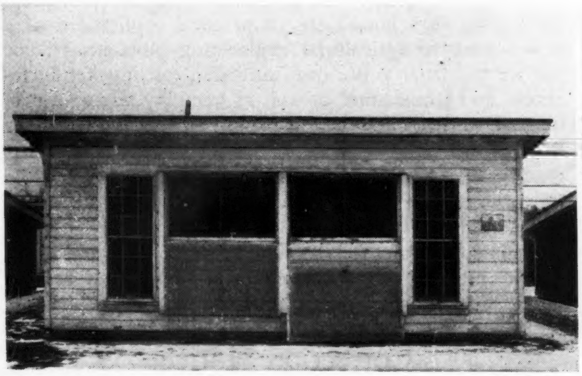
In talking with poultrymen and even many engineers, I find much confusion concerning the terms "ventilation" and "air conditioning." On this misunderstanding hinges progress in the solution of the poultry housing problem.

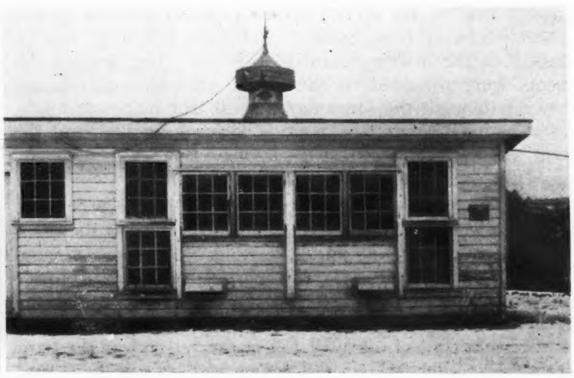
Here are my definitions of ventilation and air conditioning as I would use them with reference to poultry housing.

Ventilation is the process of removing used air from

Presented before the Farm Structures Division of the American Society of Agricultural Engineers at Chicago, Ill., December 1, 1936.

Author: Professor of agricultural engineering, Cornell University. Mem. ASAE.





TWO COMPARATIVE TEST POULTRY HOUSES

(Left) Cornell University experimental ventilated pen, the "open-front house." Even with heat, this pen had damp litter at times throughout the winter. Ceiling rafter outtake, set-out curtain intake, no insulation, 125 birds in a 20x20-ft pen. (Right) Cornell University experimental air conditioned pen, the "closed house." The air space between studs and between rafters is packed with shavings. Storm sash cover windows. Floor outtake flue and floor intakes. This house is closed the latter part of November and remains closed until the early part of April. The litter is dry all winter and a temperature difference of about 20 F is maintained in normal weather. In extremely cold weather the temperature difference is somewhat greater with 125 birds in a 20x20-ft pen

and supplying fresh air to any enclosed space by mechanical or natural means.

Air conditioning is the *control*, by natural or mechanical means, of the temperature, humidity, air movement, and purity of the air within an enclosed space, to produce and maintain environmental conditions which are comfortable for the occupants of that space.

Those two things are quite different. Ventilation implies only air flow out of and into an enclosed space. It does not imply control. It does not include any set degree of moisture removal. Air conditioning, however, implies the continuous control of a combination of factors — temperature, moisture, dust, odors, purity and air movements—for the express purpose, in this case, of keeping the birds comfortable.

I have asked myself more than once, What do the poultrymen want? Do they want ventilation, or heat, or dry floors? They probably do, but they are also groping in the dark for that control which we call air conditioning.

If we are to design a poultry house and equipment for air conditioning, we must have the answers to the following questions:

1 What temperature range is to be maintained in the particular poultry house?

2 What relative humidity is to be maintained in the particular house?

3 What degree of air purity is required?

At present these questions remain unanswered.

Much work has already been done. Some facts are available. More work needs to be done, and it would seem that our efforts now should be to clarify the problem, by determining whether the problem is made up of separate units or factors such as ventilation, heat, and dry litter, each of these in itself a prime factor; or whether the problem is one of the control of environmental conditions for the various breeds and types of bird, and climate.

For this purpose, we must recognize that the agricultural engineer, the poultry scientist, the commercial poultryman, the equipment manufacturer, and the farmer are all interested and can all contribute to the solution of the problem.

I feel that we have been, in general, doing a somewhat fragmentary job of applying engineering principles to poultry houses. We have done all that could be done under the circumstances, it is true. But new knowledge and invention change some processes, and now it seems that we need not let the poultry house just grow like "Topsy." We know, I think, what is needed, and are in a position to help secure this information.

Air Conditioning Applications to Farm Buildings

(Continued from page 72)

profitable. Growing, feeding and marketing conditions seem to favor these early lambs.

Early lambs usually do well under ordinary housing conditions in dry sheds, even in very cold weather, if they are at least a week old before they are exposed to these rigorous housing conditions. For low mortality of early lambs, a warm, dry lambing barn must be provided.

On a farm in south central Wisconsin, a 30x64 ft sheep barn was being used for lambing in February 1935, when an urgent call for help was sent in to the University. Wall fans could not keep the barn dry without lowering the temperature too much, and lambs were being lost at an alarming rate. Some rapid heat loss and humidity calculations indicated that four 500-watt heating elements would supply enough heat to dry up the barn. A blower was set up and a metal tube of 6-in diameter and some 5 ft long was installed on the discharge end of this fan. The heating elements were mounted in this metal tube, and this heater was set to work the same day the call for help was made. By morning the air had a much lower humidity, and the barn was warm enough for the lambs. But few lambs were lost after the heater was installed.

Obviously the cost of operating this heater was high, but it demonstrated the need for artificial heat to the owners. Plans were made and a haydite block furnace room was built outside and at the west end of the barn. A blower draws outside air over this furnace and forces it into the barn, thus tempering the incoming air for moisture and temperature control. A wall fan at the far end of the barn draws this tempered air the full length of the barn and discharges it from the barn.

Not only is this barn a success as a lambing barn for several hundred ewes each year—in the fall of 1935, 900 bu of corn were hung on binder twine hangers from the hayloft floor joists. The furnace and fans were used to dry what turned out to be a valuable crop of seed corn.

In this combination sheep and corn drying barn the expenditure of a small amount of money has resulted in successful and profitable farm operations. The small fuel and electric energy cost is insignificant on the annual operating statement, yet its effect on income is most gratifying.

Other Uses. Scores of Wisconsin farms now have seed corn driers using furnaces and blowers for air conditioning and circulation through bins of corn. Plans are now being made for an air conditioned hog house on the University farm at Madison. By having temperature and humidity control and forced-air circulation, it is hoped that tests may be run to determine optimum housing requirements for farrowing and pig growth.

These examples of the air conditioning of farm structures other than houses are all practical applications of a new science to agricultural engineering problems. Some day we will balance Btu cost, insulation cost, market fluctuations, and temperature as well as humidity effect on production, to determine the most economical relationships for these factors.

Insulation factors and costs are a matter of record, while Btu costs may be easily calculated. Market trends are now being scientifically forecast. Research must still determine optimum conditions for the production of milk and eggs; for the growing of pigs, lambs, and chicks; and for the storage of perishable fruits and vegetables.

Correction Notice

IN THE paper, entitled "Characteristics of Transverse Pitot Tubes," in AGRICULTURAL ENGINEERING for January 1937, there is an error in the labelling of the velocity traverses in Fig. 5 (page 22). The authors state that the curves marked "impact orifice upstream" should be marked "impact orifice downstream," and vice versa.

What Agricultural Engineers Are Doing

Contributions Invited

All public-service agencies (federal and state), dealing with agricultural engineering research and extension, are invited to contribute information on new developments in the field for publication under the above heading. It is desired that this feature shall give, from month to month, a concise yet complete picture of what agricultural engineers in the various public institutions are doing to advance this branch of applied science.—EDITOR.

Reported from USDA Bureau of Agricultural Engineering

THE heavy reconstruction program was in full operation in the CCC drainage camps of the central district by the middle of March 1936, and the 36 camps excavated a little short of one million cubic yards of earth during that month. Excavation quantities gradually increased to a peak of 2,230,000 cu yd in October. Excavation yardage for December was 1,436,000 yd. The following represents average monthly accomplishments of the 36 drainage camps during the previous nine months period: Excavation, 1,683,000 cu yd; clearing, 6,082,300 sq yd; reconditioned tile lines, 45,517 ft; structural and other work of various classes, 11,677 man-days; and total man-days per month, 86,600. The commercial value has averaged $466,300 monthly and local drainage enterprises contributed an average of $108,000 monthly. Deducting cooperation from the commercial value leaves a total of $358,300 monthly which may be called the net commercial value of government work accomplished by the staff and enrollees, an average of $4.14 per enrollee man-day.

* * * *

At a drainage school held January 7 to 9, inclusive, at the University of Kentucky, J. G. Sutton, Clark E. Jacoby, and W. H. Tyler of the Bureau delivered addresses. The school was attended by engineering personnel of the drainage camps in the Kentucky area.

* * * *

Harry G. Nickle assisted the Texas Board of Water Engineers in starting a WPA water table survey in the irrigated areas along the Pecos River. Mr. Nickle also assisted in tests of a model weir and screened water wheel in the hydraulic laboratory of the University of Texas. Aquatic growths floating in the water are collected on the screened wheel until some head is built up, at which time the wheel turns, releasing the water, and dumps the growth from the lower side of the wheel. Tests indicated satisfactory results with the wheel set at various positions in relation to the weir.

* * * *

R. B. Allyn was appointed junior irrigation engineer to assist R. A. Work at the Medford, Oregon, experiment station, and began work December 16. One of his first assignments was the preparation of a design for a concrete cutoff wall 75 ft long and 5 ft deep into bedrock. The wall will be poured against an undisturbed wet earth plot in which experiments are to be carried on for determination of the effect of carbon dioxide concentrations on root growth in wet soils.

* * * *

A new experimental cross-over checkrower is under construction at Ames, Iowa for a six-row, 21-in corn planter, according to C. K. Shedd. This is similar to the device built on the four-row, 42-in planter last summer.

* * * *

The Third Annual Sugar Beet Round Table Conference held at Fort Collins, January 5, 6, and 7, formally organized the American Society of Sugar Beet Technologists. This conference, in which E. M. Mervine has participated, giving progress reports on sugar beet machinery, was attended by 85 executives of the sugar beet industry from 12 states and Canada.

* * * *

S. W. McBirney, stationed at Davis, California, reports that design work on a small planter unit, for securing uniform seed spacing of sugar beet seed, has been completed and construction of the unit has been begun. This unit uses a feed chain of small seed-ball cups designed to drop one seed ball in each inch of row.

* * * *

Two experimental pyrethrum harvesters are being constructed by Geo. R. Stafford and W. M. Hurst, at Arlington Farm, in cooperation with the Bureau of Plant Industry. These machines will be tested in Maryland, Pennsylvania, and West Virginia early next summer.

Reported from the Agricultural Engineering Department, Pennsylvania State College

A REPORT of the second season's work with tillage tools has been prepared by A. W. Clyde and will appear soon in AGRICULTURAL ENGINEERING. Tests were made on conventional and speed-type plow bottoms; on attachments such as the rolling colter, jointer, and the new USDA self-aligning disk jointer; and on the disk plow and disk harrow. Further applications of results are being made to getting bearing loads, planning of shop strength tests, and hitching.

Tests are being planned for some new types of spring teeth and for an improved spring-trip cultivator shank. The latter has been used considerably and has never failed to return to working position after being tripped.

* * * *

D. C. Sprague, with a teacher trainer from the agricultural education department, conducted during the past year a series of farm mechanics meetings for teachers of vocational agriculture. Five one-and-one-half-day meetings were held during the past year at which about 60 per cent of the vocational agricultural teachers of the state attended. At each of these meetings one-half day was devoted to farm electricity. Other enterprises taken up were selected by the teachers themselves. The number attending any one meeting was limited in order that all might participate in the work.

Mr. Sprague is also cooperating with the zoology department in the study of methods of stream improvement. Stream improvement devices are being studied from the standpoint of their effect upon the channel of the stream and upon the fish life within the stream.

* * * *

Pathologists and agricultural engineers are experimenting with the steam method of vaporization of water for spraying plants to protect them from diseases and insect pests.

A "kid-glove," two-row potato digger has been developed. The elevator chain is made of V-shaped bars with wood inserts. The soil adheres to the wood and appears to minimize bruising of the tubers. The machine digs the two rows and the middle in one swath. It is finding favor with discriminating potato growers. The device is strongly designed and built. It drives by power take-off from the tractor, by engine, or by traction.

* * * *

The Pennsylvania State College is one of ten colleges cooperating with the American Society for Testing Materials in a series of tests on corrosion of wire fencing due to atmospheric exposure.

At each test site there are approximately 96 samples of farm field fence, 142 of plain wire, 27 of barb wire, 13 of strand wire, and 4 samples of chain link fence. The sites are selected to give a wide range of exposure conditions. Tests are designed to yield data evaluating only such factors as kind and weight of coatings, composition of base metal, gage of wire, etc., and do not in any way represent any one manufacturer's product.

* * * *

In rural electrification research, under John E. Nicholas, Bulletin 338, entitled "Methods of Heating Hotbeds," has recently been published. Another bulletin is being prepared on "Comparative Methods of Brooding."

A new project has been recently approved to study the electric fence.

Reported from the Agricultural Engineering Section, Extension Division, Pennsylvania State College

THE year's work in agricultural engineering under the Division of Agricultural Extension, shows more persons reached with improved or changed practices in 1936 than in even the boom year of 1929. The scoring is done under what are called "farm contacts," and this year's totaled over 3500. Practically every item requires money to be spent by the farmer. All of the 65 counties with county agents turned in results in engineering.

The septic tank forms are more and more becoming a local leader proposition and reports from these are scarce. The records show 94 tanks built, 760 cases of individual assistance, and exactly 1,000 persons attending 15 general meetings. This is five times the interest shown last year. Previous work showed its results, as there was no typhoid epidemic following the flood of March 1936, which reached at least half of the state. Our infection rates on typhoid are now too low to tabulate. Water supply work usually emphasizes *(Continued on page 77)*

NEWS

Joint Meeting on Agricultural Processing

THE American Society of Agricultural Engineers has joined the Process Industries Division of the American Society of Mechanical Engineers and the Farm Chemurgic Council in sponsoring a one-day meeting on agricultural processing to be held at Rutgers University, New Brunswick, New Jersey, Friday, February 26.

This meeting is planned to bring together for group consideration the chemists and physicists who originate processes of making new useful products from various farm-grown materials; the processing engineers who develop and apply the processes on a commercial scale, and the agricultural engineers who are interested in enabling farmers to deliver the basic materials to processing plants within the required limits as to cost, physical condition, and time and quantity of delivery.

R. U. Blasingame, president of ASAE, and professor and head of the agricultural engineering department, Pennsylvania State College, will preside at the morning session to open at 10 o'clock. Papers scheduled for this session include "Processing Research in Agriculture," by John F. Ferris, acting director of the Agricultural Industries Division of TVA; and "Hemp and Flax from the Seed to the Loom," by George A. Lowry, of Lowry and Grant.

A "Research Luncheon" will be held at the Elks Building at 1:00 p. m. Dr. W. H. Martin, director of research of Rutgers University, will address the group on "Agricultural Research Work," and Dr. Paul L. Hoover, director of the New Jersey Engineering Experiment Station, will talk on "Engineering Research."

Victor Wichum, chairman of the Process Industries Division of the American Society of Mechanical Engineers will preside at the afternoon session. "Processing Engineering in Agriculture" is the subject of an address with which L. F. Livingston, past-president of ASAE, and manager agricultural extension section, E. I. du Pont de Nemours & Co., will open the afternoon program. He will be followed by C. E. Thomas and A. Weisselberg, of the drying committee of the ASME Process Industries Division, with a paper on "Drying of Agricultural Products — The Technical and Economical Aspects."

R. C. H. Heck, of the department of mechanical engineering, and E. R. Gross, head of the department of agricultural engineering, Rutgers University, are the committee in charge of local arrangements for the meeting.

The morning session is to be held in the Physics Auditorium, and the afternoon session in the Dairy Building, on the Rutgers University Campus. All interested persons are invited to attend. There will be a registration fee of $1.00 per person which will include the luncheon.

Annual Report of the Executive Secretary, American Engineering Council

ACTIVITIES of the Council for the past year have been summarized by the executive secretary in a bound mimeographed report dated January 15, 1937. His summary is supplemented by a complete report of meeting proceedings of the year 1936, and reports of Council's various committees.

Activities of particular interests to agricultural engineers are summarized in part as follows:

"*Upstream Engineering Conference*: Here again, was a government conference of engineers called under the government auspices, about which there was much confusion as to purpose and policy. Our three founder member organizations preferred not to be officially represented at this conference, but requested that American Engineering Council lend its offices to help in the development of this conference in such ways as would not commit our member organizations to any questions of national policies. This was not an easy assignment, but after conferring with officials of the conference and of our member organizations, the Executive Secretary agreed to serve as chairman for one of the sessions and those in charge of the conference asked for and received the names of engineers who could personally contribute either papers or discussion. These recommendations were accepted by the committee in charge of the conference, and the details of that conference were reported in the News Letter of October 15.

* * *

"*Cooperation with National Water Resources Committee*: As a part of its Water Resources Committee's program, the National Resources Committee invited and paid the expenses of a number of prominent engineers and engineer representatives of engineering organizations to a meeting of its own on water resources paralleling the Upstream Engineering Conference. There was no conflict because this delegation attended the directly related sessions of the Upstream Engineering Conference and some of the discussions carried over from meeting to meeting. Excellent practical comparisons of opinions and experiences were made, but the feature of the Water Resources Symposium was the enlightening report of Abel Wolman of Baltimore for the Water Resources Committee of the National Resources Committee. Mr. Wolman effectively outlined a thorough understanding of their objectives, summarized their activities to date, and stressed their recognition of the need for real cooperation in their effort to coordinate a mass of valuable information on water resources, conservation and use. Nothing really new developed from this meeting, but the committee made a direct bid to engineers in private practice as well as those in public service for advice and assistance in the preparation of information to be made available to everyone who may increase its usefulness. In connection with the practical use of such information, this meeting also stressed the value of interstate compacts or regional action without hindrance to administration by differences between political subdivisions.

* * *

"*AEC Requested to Participate in International Management Conference in* 1938: In the same direction of coordination, the American Committee for the sponsorship of the International Congress in Management to be held in the United States in Washington, D. C., in 1938, has requested the American Engineering Council to participate and has asked that the executive secretary of the American Engineering Council serve in that capacity for the Management Congress.

* * *

"*Public Works*: This question is perennially before American Engineering Council; first, the consideration of government organization. The recommendations of Council as to the value of centralizing a Department of Public Works have been transmitted to the Brookings Institution and to the President's Committee on Administrative Management, which has been collecting information for Senator Byrd. In the second place, consideration of principles which should guide the expenditure of monies for public works. During the last year, the question of public expenditures for public works, as in the two previous years, has been interwoven with the question of administration policies for expenditures of relief. The staff of Council has kept in touch with many phases of this situation and specific actions have been reported from month to month in the News Letter.

* * *

"*Mapping and Surveying*: The Federal Board of Surveys and Maps, a government body for coordinating the work of the many mapping agencies of the government, has officially requested Council to forward in such ways as it can a national mapping program. The American Association of State Geologists has offered its cooperation with the Council's committee on surveys and maps. The committee is formulating plans to bring together in educational form to make available for both state agencies and federal agencies, the public values of a basic mapping program.

* * *

Stream Pollution and Flood Control: The staff of Council has served as a center of information on the various bills which have been introduced on these two subjects and special reports on the status of the various bills have been prepared at the request of Secretary Seabury for the American Society of Civil Engineers. Quick action secured by Council on short notice for this information brought appreciative telegrams from Secretary Seabury.

The American Institute of Consulting Engineers has forwarded resolutions on flood control. This information has been placed at the disposal of Council's committee on conservation and utilization of natural resources. This question is one of general importance with many ramifications and Council may be expected to have much to do with it the coming year.

Engineering Unemployment Report Published

According to a survey of the engineering profession, undertaken by the Bureau of Labor Statistics at the request of American Engineering Council, more than a third of the professional engineers in the country were unemployed for varying periods within the five years 1929-34. Among those who became unemployed during these five years, half were out of employment for more than a year, except as they found work on relief projects. The survey covered 52,589 professional engineers. The detailed information is included in an article entitled "Unemployment among Engineers", in the January issue of the Monthly Labor Review.

"Between the end of 1929 and 1932, the percentage of engineers who were unemployed increased from 0.7 to 10.9. At the end of 1934 the percentage of unemployed was 8.9. This slight improvement was not wholly accounted for by a return to normal fields of engineering activity. In the main, it was due to increased employment on non-engineering work."

A limited number of copies of the complete article in reprint form will be available from the American Engineering Council.

What Agricultural Engineers Are Doing

(Continued from page 75)

sanitation, but nine demonstrations were held which included some irrigation.

Under drainage, all but five counties show work. There were 31 demonstrations and 4 general meetings, with a combined total attendance of 227. Besides these, 384 farmers got individual help, mostly from the county agents who have hand levels. Three of the demonstrations were on dynamited ditches.

Electrification work would require a book to describe fully. Our new IES pin-up lamp and 3-point adapter make a hit. Three times more people turned out to meetings than last year, with a total of 1070 at 25 meetings. Besides this, over 300 farmers received individual help from the county agents.

In Pennsylvania we laid the foundations for the Northeastern Farm Building Plan Service with a big boom in building. All counties but 5 report some of this work. The 585 requests for help were 20 per cent more than were received last year. There was a big demand for the old 1929 USDA extension plan book, after the flood. Ventilation on the Cornell system is taking well.

Machinery is taking an up swing with an even 600 at meetings, 10 times as many as in 1935, and 137 cases of special assistance. A new farm survey blank will bring out a number of important items wherever a locality is covered.

Farm fire prevention and protection is being recognized. Four meetings brought out 585, with 42 getting individual help. We are making headway with the insurance people. Our releases on spontaneous heating after the flood and a cyclone followed by rain, brought good response.

The 4H farm shop clubs are doing good work. We aim to get boys of 16 years and older. Eight clubs with 98 members held 39 meetings, with an aggregate attendance of 402. This was separate from the club camps, where tool sharpening was given to all club boys, whether they were enrolled in shop clubs or not. While this work is mostly in the fundamentals of carpentry and metal handling, to insure the equipment of a good shop, we hope to expand it to machinery adjustment and repair when the necessary assistance is available. All of the local meetings have been handled by the county agents with the help of good local leaders.

ASAE Meetings Calendar

June 21 to 24, 1937—Annual meeting of the Society—University of Illinois, Urbana-Champaign.

Necrology

Johann Friedrich Max Patitz, a member of the American Society of Agricultural Engineers since 1914, passed away in Milwaukee, Wisconsin, January 3, 1937, as he left a funeral parlor where he had paid his last respects to a deceased friend. He had been associated with the Allis-Chalmers Manufacturing Company and its predecessor, the E. P. Allis Company, for the past 51 years, during which time he worked up from office boy to chief consulting engineer. He filled the latter position for the past 25 years. Mr. Patitz had a large part in the development of products manufactured by the company and was put in charge of the engineering end of the company's entrance into the farm machinery field in 1914.

One sister, Miss Martha Patitz, succumbed within a short time after learning of her brother's passing. Mr. Patitz is survived by two other sisters, Miss Elizabeth Patitz of Milwaukee, Mrs. Mary Daus of Sturgon Bay, Wisconsin, and a niece, Mrs. Frieda Baum, also of Sturgeon Bay.

* * *

John Wilbert Purcell passed away January 6. He was born at Listowel, Ontario, Canada, and left school at the age of 18 to enter the electrical industry. He worked in various electrical manufacturing plants in Detroit, Michigan, until 1894, when the Detroit Electric Light and Power Company placed him in charge of its electrical machinery and equipment repair work. He moved up to become head of the maintenance of service department, and later, general superintendent. In 1896 he left that company to accept a position as superintendent and engineer in charge of the electrical department of the Walkerville (Canada) Electric and Power Company. In 1912 he was employed by the Hydro-Electric Power Commission of Canada as assistant engineer in the municipal engineering department. His duties with the Commission have been those of assisting in developing loads in urban municipalities and rural districts. More particularly he devoted his time to the development of applications of electricity to farm uses. In addition to working out electric motor applications to existing farm equipment, he was instrumental in the development of improved and more economical methods of performing operations, either by changing the design of equipment or by applying electricity to new purposes. Two outstanding examples are the development of grain choppers using small motors and specially designed cutters, and the applications of electric power to plant growth, seed propagation and soil heating. He became an Associate Member of the ASAE in 1927. One sister, Miss Nina Purcell of Stratford, Ontario, survives him.

Personals of ASAE Members

Henry Giese, H. J. Barre, and J. B. Davidson, are joint authors of Research Bulletin 207 of the agricultural engineering section of the Iowa Agricultural Experiment Station. It is entitled "Masonry Barn Design and Construction."

L. F. Livingston was recently made one of the honorary vice-presidents of the American Forestry Association. Mr. Livingston is manager of the agricultural extension section of the E. I. du Pont de Nemours & Company, and served ASAE as president during the Society year 1935-36.

Vernon S. Peterson has been appointed extension specialist in agricultural engineering at Pennsylvania State College, with the title "assistant professor of agricultural engineering extension." He is a graduate of Kansas State Agricultural College. For three years he served as extension agricultural engineer in Iowa, and more recently as state administrator in the USDA Soil Conservation Service in Indiana.

Joel A. Wier, Jr., has recently been appointed engineer in charge of sanitation, child health demonstration project, department of public health, State of Georgia. His new address is Box I, Sparta, Georgia. He was formerly connected with the Georgia State Highway Department.

Applicants for Membership

The following is a list of applicants for membership in the American Society of Agricultural Engineers received since the publication of the January issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

George J. Burkhardt, associate agricultural engineer, Bureau of Agricultural Engineering, U. S. Department of Agriculture. (Mail) Agricultural Experiment Station, Mayaguez, Puerto Rico.

D. W. Cardwell, junior agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Spartanburg, S. C.

C. R. Carlson, Jr., assistant manager, John Deere Tractor Co., Waterloo, Iowa.

Ross Hanson, research specialist and engineer economist, Resettlement Administration. (Mail) 404 Donaghey Trust Building, Little Rock, Ark.

Dale E. Harper, assistant agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Box 21, Torrington, Wyo.

Lloyd W. Hurlbut, instructor in agricultural engineering, University of Nebraska, Lincoln, Nebr.

Drayton T. Kinard, instrument man, Resettlement Administration. (Mail) Ninety Six, S. C.

Everett C. Kneece, service manager, International Harvester Co. (Mail) 1704 Thomas Ave., Charlotte, N. C.

John D. Nicol, junior foreman, drainage maintenance work, Bureau of Agricultural Engineering, U. S. Department of Agriculture. (Mail) Clarion, Iowa.

J. R. Register, Jr., field service instructor, International Harvester Co. (Mail) Box 1241, Wilson, N. C.

James H. Willson, secretary-treasurer, Athens Plow Co., Athens, Tenn.

Agricultural Engineering Digest

A review of current literature by R. W. TRULLINGER, senior agricultural engineer, Office of Experiment Stations, U. S. Department of Agriculture.

EXPERIMENTAL VERIFICATION OF PUMP WELL THEORIES, *T. R. Collier* and *W. Gardner*. Utah Acad. Sci., Arts and Letters, Proc., 12 (1934-35), pp. 177-179, figs. 2. In a brief contribution from the Utah Experiment Station an attempt is made to verify experimentally the conclusions of Eliason and Gardner reported in a previous article.

STIRRING AIR WITHIN DESICCATORS, *F. J. Zink*. Indus. and Engin. Chem., 7 (1935), No. 6, pp. 442, 443, figs. 3. In a brief contribution from the Kansas Experiment Station a simple means of stirring air within desiccators is described, which was used in a series of investigations of equilibria moistures of forage hays and grains.

The equipment consists essentially of small fans mounted on pivots inside the desiccator which are induced to rotate by a series of mechanically moved permanent magnets passing near the outside of the desiccator.

AGRICULTURAL ENGINEERING INVESTIGATIONS AT THE NORTH DAKOTA STATION, *H. F. McColly*. North Dakota Sta. Bul. 286 (1935), pp. 60-62. The progress results are briefly presented of investigations on farm refrigeration methods, the use of tractors on farms in various parts of North Dakota, and temporary silos.

EFFECT OF NATURE OF FILLING MATERIAL AND DOSING CYCLE ON PURIFICATION OF CREAMERY WASTES, *M. Levine, G. H. Nelson,* and *H. E. Goresline*. Iowa Engin. Expt. Sta. Bul. 124 (1935), pp. 56, figs. 3. The effects of various filling materials and dosing cycles upon the purification effected by, and the rate of discharge from, trickling filters were investigated in these studies, and the influence of the rate of discharge on the composition of the effluents was also observed.

Sectional lath and cinder filters and solid cinder, quartzite, gravel, spiral ring packing, broken tile (burned clay), and corncob filters were studied. All filters were 2 ft square and 6 ft deep. Sectional filters consisted of six sections, each a foot high, separated vertically by 4-in spaces.

The waste was skim milk applied at the 24-hr dosing rate of 550,000 gal per acre. Actual application was made over a period of from 16 to 20 hr per day. The concentration of the waste varied from about 200 to 1,600 ppm oxygen demand.

Extremely high efficiencies were obtained with cinders but they clogged quite frequently so that it was necessary to wash the filter after about 5 mo of operation. Moderate doses of $MgSO_4$, $CaCl_2$, and Na_2SO_4 did not affect the cinder filter efficiency.

The purification effected by corncobs was unexpectedly high, although nitrification did not develop. The corncob filter bed shrank 35 per cent in depth. Efficiency decreased sharply at the end of the test, perhaps indicating an imminent failure in the purification function.

The 3-in spiral packing was too large for outstanding results. Nitrification was quite satisfactory, however, and for smaller rings excellent results can be expected without danger of the clogging which eventually ensued in cinders, gravel, and broken tile.

Dosing cycles did not affect the efficiency of cinder filters, but on the quartzite the efficiency decreased as the length of cycle increased. Nitrate content of effluent was not affected. Probably some of the wastes were short circuited with the longer dosing cycles. With the longer cycles there were surges of comparatively unpurified sewage. Short cycles (2.5 to 5 min) effected higher purification, more constant runoffs, and more nearly uniform composition of effluents than did longer cycles (20 to 22 min).

The more uniform the rate of runoff the more nearly the peak efficiency is reached for any given load.

LOAD PERFORMANCE TESTS OF PRECAST-JOIST — PRECAST-SLAB FLOOR CONSTRUCTION, *R. E. Copeland*. Jour. Amer. Concrete Inst., 7 (1935), No. 2, pp. 195-211, figs. 9. The tests reported were conducted on a type of light weight concrete floor constructed of precast reinforced concrete slab sections laid on and united to precast reinforced concrete joists. Seventeen large panels were tested. The variables included type of aggregate, composition and strength of the bond mortar, bond joint design, texture of the mortar contact surfaces at the bond joint, span of panel, and type of loading. Haydite and sand and gravel were selected as being representative of the light weight and standard weight aggregates. The two types of mortars used for the bond joints are commonly referred to as cement mortar and cement-lime mortar. The bond joint designs included those depending on cement bond alone and types providing mechanical bond in addition to cement bond. The mortar contact surfaces were made rough for some panels and smooth for others. All panels were of 14-ft clear span except one of 20-ft span. All panels were tested with uniformly distributed load except one panel where the load was applied at the midspan and quarter points.

The loads placed on the panels ranged from 40 lb per sq ft for the panels having the weakest bond joints, to 445 lb per sq ft. Yield point stress in the tension steel was produced by a load of 200 lb per sq ft in the case of the panel with joists functioning as independent members and by loads of from 275 to 288 lb per sq ft in the case of 14-ft span panels functioning as a T-section.

The deflections due to the weight of the slabs averaged about 0.12 in for the 14-ft panels and 0.2 in for the 20-ft panel.

The plain bond joint, type 1, whose shear resistance depends wholly on the adhesion of the mortar to the precast members, gave the poorest results. This type of joint, with smooth textured mortar contact surfaces, failed with panel loads of 40 lb per sq ft, and with rough textured mortar contact surfaces failure occurred with panel loads of from 40 to 160 lb per sq ft. Joint types 2 and 3, providing for a mechanical bond by interlocking the slab units with the joist, performed very satisfactorily and were relatively stronger in panel load capacity than the tension reinforcement. Joint types 4 and 5 differed from types 2 and 3 in that the slabs were not actually interlocked with or morticed into the joists. Mechanical bond was obtained by means of the irregular or serrated mortar contact surfaces forming a series of small mortar keys. Joint type 4 fractured at a load of 220 lb per sq ft. Joint type 5 was relatively stronger than the tension reinforcement but failed at a load of 218 lb per sq ft.

The results in general are taken to indicate that it is possible and practicable to construct precast-joist—precast-slab floors in such a manner that the joist and slab function together as a T-section.

Considering the range of mortar strengths studied, strength of mortar was not an important factor. It does not follow, however, that a weak mortar would be satisfactory. It is believed that the mortar should be at least as strong as the 1:1:6 cement-lime mortar used. Panels constructed of Haydite concrete performed similarly to comparison panels made of sand and gravel concrete. Within the range of conditions studied, variations of span length and type of loading produced no appreciable effect on load performance.

AGRICULTURAL ENGINEERING INVESTIGATIONS AT THE MICHIGAN STATION, *H. H. Musselman*. Michigan Station Rpt. 1935, p. 158. A very brief progress report is presented of investigations on bindweed control equipment, porous canvas hose irrigation, low-pressure tires on tractors, improved farm buildings, and hay storage.

AGRICULTURAL ENGINEERING INVESTIGATIONS AT THE SOUTH DAKOTA STATION, *R. L. Patty*. South Dakota Sta. Rpt. 1935, pp. 8-11. The progress results are briefly presented of investigations on field machinery hitches for tractors and large horse teams, rammed earth for farm building walls, corn harvesting machinery, protective coverings and length of service of steel fence posts, and rammed earth walls in poultry house construction.

AGRICULTURAL ENGINEERING AND WATER AND SEWAGE INVESTIGATIONS AT THE NEW JERSEY STATIONS, New Jersey Stas. Rpt. 1935, pp. 12-14, 89-94. The progress results of investigations on sweet potato storages, farmhouses, drainage, and terracing are briefly presented.

Progress results are also briefly presented of studies on activated sludge, sewage chlorination, chemical precipitation of sewage, sewage sludge dewatering, use of activated carbon in sewage treat-

ment, pathogenic organisms in sewage, and high and low temperature digestion of sewage.

SEWAGE CHLORINATION STUDIES. *W. Rudolfs and H. W. Gehm.* New Jersey Stas. Bul. 601 (1936), pp. 72, figs. 27. Laboratory studies on sewage chlorination are reported.

An attempt was made to determine the chlorine consumption of sewage, the effect of chlorine on the flora and fauna, the effect of some physical and chemical factors on the action of chlorine, and the effect of chlorine on oxidation. Sewages obtained from different sources were completely and partially chlorinated, and the quantities of chlorine required by different fractions (soluble, finely divided, and coarse suspended solids) were determined. To obtain a clearer picture, representative groups of substances present in sewage were treated singly in pure forms, allowing the indication of possible linkages of the chlorine with the compounds. It was found that with complete chlorination the settleable and soluble substances each consumed about 25 per cent and the nonsettleable about 50 per cent, but that on the basis of weight the finely divided material (colloidal and pseudocolloidal) consumed about 65 per cent, the nonsettleable solids about 30 per cent, and the settleable together with the soluble substances only 5 per cent of the chlorine added. The quantity of chlorine consumed by the bacteria present is, for practical purposes, negligible.

The turbidity of settled sewage and of activated sludge increased upon chlorination. Portions of the dispersed materials became soluble, and the fraction made soluble consisted of nitrogenous substances.

Of the several methods tried to determine residual chlorine, a slightly modified orthotolidine test gave consistent results.

Bacterial removal ([*Bacterium*] *coli* and 20 C count) from sewage varied with the quantity of chlorine added, the contact time employed, and the types of substances present. The reduction in numbers of organism, both *B. coli* and total bacteria, was followed by great increases after continuous incubation. In all cases, except when 100 per cent of the chlorine demand was satisfied, growth increased in 6 hr after chlorination, but none reached the original numbers until after 24 hr of incubation. The aftergrowth was not directly proportional to the quantities of chlorine added. Microscopic examination of the sewage showed that with from 50 to 75 per cent of the chlorine demand satisfied, the fauna was reduced to such an extent that no protozoa were present after 75 hr incubation. The greater the initial reduction of bacteria the longer the lag, followed by a more rapid increase. The aftergrowth showed a predominance of the pseudomonas pigment-forming bacteria, indicating a selective action of the chlorine. A description of the chlorine-resistant organism is given.

Split chlorination kills as many bacteria with the same quantity of chlorine as does addition in a single dose, but chlorine consumption is about 7 per cent higher when chlorine is added in successive doses. Adding chlorinated sewage to unchlorinated sewage reduces the bacterial numbers in proportion to the final dosage of chlorine. These results indicate that by prechlorination and split chlorination the greatest use is made of the chlorine added.

Within the limits of from 5 to 37 neither bacterial reduction nor chlorine demand was appreciably affected by temperature in fresh or stale sewage. Increasing the speed and the time of mixing chlorine with sewage does not result in greater kill. Penetration of the chlorine with proper mixing is very rapid, and a single thorough mixing is all that is necessary to obtain maximum bacterial removal in up to 10 min contact time. Hydrogen sulfide present in sewage may interfere to some extent with bacterial removal, but other substances produced during decomposition, which are usually present in stale sewage or settling tank effluents, are of greater importance. The same quantity of chlorine added to sewage but varying in strength from 100 to 1,070 ppm, (parts per million) did not cause any difference in the bacterial kill. In plant practice the concentration varies widely, depending upon the chlorine demand and the quantity of sewage, as well as upon the type of chlorinator used. Maximum bacterial kill can be obtained, therefore, with any type of chlorinator or any strength of chlorine, provided good mixing is allowed, and chlorine consumption can be reduced by control.

The effect of chlorine upon biological oxygen demand reduction of carbon oxidation, showed that when regular 5-day bod determinations are made the bod will be lower when a contact time of only 10 min is allowed with chlorine and the same type and quantity of such material are used. The effect of the chloro products formed does not seem to extend beyond the first 6 days of incubation. Partial chlorination of sewage lagged behind unchlorinated sewage but was persistently greater than the sewages chlorinated to 100 per cent of the demand. The 5-day bod reduction in 42 samples of different sewages was 2.4 ppm for each part per million chlorine added, while samples of very stale sewage showed an average reduction of 2.6 ppm biological oxygen demand for each part per million chlorine added. With shorter and longer incubation periods the bod reduction was less or more, depending upon the incubation time. The reduction of bod depends upon the quantity of chlorine added, but the total bod reduction is practically constant, with quantities of chlorine added as low as 20 per cent of the demand. Consequently, the more chlorine is added the less apparent bod is removed when calculated in parts per million bod reduction for each part per million chlorine added. The results are correlated with the effect of chlorine upon the soluble and semisoluble material.

During the first 5 days of incubation less carbon was oxidized from the chlorinated sewage than from the unchlorinated, but after 10 days' incubation the quantities of carbon oxidized were the same. Corresponding bacterial results explain the initial retardation and the following rapid rise in activity of the chlorinated sewages.

A list of 44 references to other work bearing on the subject is included.

SOIL AND RAINFALL CONSERVATION IN NEW MEXICO. *C. P. Wilson, P. E. Neale, K. W. Parker, and H. N. Watenpaugh.* New Mexico Sta. Bul. 238 (1936), pp. 45, figs. 28. A large amount of practical information is presented, with particular reference to New Mexico conditions.

Part 1 relating to range lands contains sections on effects of overgrazing on plant cover, plants for erosion control, and effect of plant cover on soil erosion.

Part 2 relating to farm lands contains sections on soil properties affecting erosion and suggested methods for soil and rainfall conservation, with particular reference to the prevention of water and wind erosion and flood water utilization and control.

The experimental data accumulated indicate that the problem of soil and rainfall conservation in New Mexico is, in some respects, more difficult of solution than in a majority of the other states. It is evident that, as elsewhere, reseeding by the use of native or introduced plants will be one of the most practical means of reducing erosion. However, largely on account of the scant and erratic precipitation and the depredations of rabbits and other rodents, the results of range reseeding operations are often very uncertain. The fact that much of the soil is rocky and that a large percentage of the land which is eroding badly is occupied to some extent by plants of little economic value, will make reseeding with more valuable species more difficult and expensive than it otherwise would be. As a rule, native species have been found to be better adapted for reseeding in the state than introduced plants.

Although torrential rains seldom occur in any one locality in this part of the country, they will make heavy demands on soil and moisture conservation structures.

If it seems probable that land at present in pasture in the dry-farming areas of the state will blow to a considerable extent if plowed and devoted to crop production, such land should remain in pasture.

THE VERTICAL DRIER FOR SEED COTTON, *C. A. Bennett and F. L. Gerdes.* U. S. Dept. Agr., Misc. Pub. 239 (1936), pp. 22, figs. 16. This publication supersedes Miscellaneous Publication 149. It describes the vertical drier for seed cotton developed by the USDA Bureau of Agricultural Engineering for carrying out the government process of artificially drying seed cotton.

In this drier the drying chamber contains no moving parts, and the seed cotton is carried through it by the blast of drying air. Because of the simplicity of this design it is more economical to construct and to operate than the earlier types. Moreover, to an appreciable degree this type automatically adjusts the period of exposure in the drying chamber to the degree of dampness of the cotton, because that which has little moisture moves through the chamber more quickly than that which has much moisture. This drier has proved satisfactory in actual service under wide variations in conditions.

Very wet cotton can be dried by passing it through the drier a second time. The apparatus will condition seed cotton for ginning in any kind of weather, provided the dried cotton is conveyed from the drier directly to the gins in the heated air.

Information on installation and operation is included.

FARM IRRIGATION PUMPING PLANTS, *A. S. Curry.* New Mexico Sta. Bul. 237 (1936), pp. 44, figs. 21. Technical information of a generally practical character is presented on the development and sinking of wells for farm irrigation pumping and the selection and installation of pumping plants and necessary equipment. An appendix gives the text of the New Mexico law relating to underground water. *(Continued on page 84)*

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CORROSION: CAUSES AND PREVENTION, *F. N. Speller.* New York and London: McGraw-Hill Book Co., 1935, 2. ed., pp. XIII + 694, figs. 141. This is the second edition of this book. It contains chapters on nature and mechanism of corrosion—theories of corrosion, influence of methods of manufacture and treatment, influence of factors internal to the metal—composition, influence of factors external to the metal—classification of corrosion, principles and methods of corrosion testing, relative corrosion of ferrous metals, prevention of corrosion in the atmosphere, prevention of corrosion underwater, prevention of corrosion in closed water systems by removal of dissolved gases, prevention of corrosion in high-pressure steam plants—boiler water treatment, prevention of corrosion in steam and hot water heating systems, prevention of corrosion in chemical industries, prevention of corrosion underground, and stray-current electrolysis.

The book also contains an appendix on the calculation of corrosion rates in terms of penetration in inches per year, the marble test of Von Heyer, determination of sodium sulfite, and retarding corrosion in refrigerating plants and a selected bibliography on the corrosion of ferrous metals.

ONE HOUR FIRE TEST OF FIRE-RETARDANT WOOD DOOR, *A. S. Williams.* Amer. Wood-Preservers' Assoc. Proc., 31 (1935), pp. 225-229, figs. 3. In this experiment the test assembly consisted of a flush-type wood door 1¾ in thick, 36 in wide, and 79¾ in high. The door was composed of a fire-retardant wood core constructed of chestnut strips approximately 1⅜ in wide, assembled so as to form two 5-in stiles, running the full length of the door and joined by four 10-in cross rails, thus providing for three panels 13¼ by 26 in, which in turn were divided at the middle by means of a 5-in short stile joined to the cross rails. The rails were joined to the stiles by tongue-and-groove joints supported by dowels. The core thus assembled was covered with a 1/16-in cross band of fire-retardant poplar, and the door was finished with 1/16-in untreated birch veneer. The door was hung with 1/16-in clearances at top and sides and 3/16 in at bottom. The test structure consisted of a gas-fired furnace having an opening 62 by 93 in, which formed one wall of a vestibule with the test assembly in place.

The test was conducted in accordance with the procedure outlined in the Standard Fire-Test Specifications C 19-33 of the American Society for Testing Materials. The temperature rise on the unexposed face of the door was 176 F (degrees Fahrenheit) above the initial vestibule temperature. The door showed practically no deformation at the end of the test and remained secure in the frame. The unexposed face of the door showed no discoloration, and at no time did flame appear on the unexposed face. No smoke was evolved by the test assembly, and only a small amount of smoke passed through the openings when the furnace damper was closed near the beginning of the test.

ELECTRICITY IN POULTRY FARMING, *C. A. Cameron Brown.* Oxford: Univ. Oxford. Inst. Res. Agr. Engin., 1935, pp. 73, pls. 12. This is a conservative analysis of data relating to the uses of electricity on poultry farms in England, as gathered from a survey of the experiences of a large number of farmers in different parts of the country and as obtained from the work of various research institutions.

It is concluded that the use of electrical methods in poultry farming has become technically successful. The fear of current failure appears to be the biggest single objection to the general adoption of electrical methods where the cost is favorable.

With reference to the cost of running, all-electric incubators using current at 1.25d (pence) per unit compare favorably with oil-heated machines, bearing in mind the extra labor and the wastage with oil. At 1d per unit the all-electric incubator is as cheap as oil under average conditions on all grounds, and at prices less than 1d the all-electric machine is cheaper. While the economic results are best in the bigger cabinet machines, the use of electricity in the smaller and in the table machines is particularly appreciated in districts where poultry farming is incidental to mixed farming.

For rearing, electricity cannot compete with oil or coal-fired, central-heated, hot-water plants on large farms, but it is better than oil for battery brooding and the cost is reasonable at unit prices up to 1.25d or so. For hover heating it is competitive with oil at the same price per unit only if great care is taken in operating the controls or if automatic control is fitted and a rate of from 0.5 to 0.75d per unit is necessary to allow hover heating to be developed to any extent.

Lighting of laying houses is successful, but the costs determined in tests should be related to prevailing market prices. The application showed a substantial profit per bird in the conditions experienced during the 1930-31 season.

With reference to the quality of output the electrical methods are criticized in some quarters on the grounds of producing poorer and less virile birds. This does not appear to be true in connection with rearing, compared at least with other methods of heating, but in hatching there is definitely a tendency to hatch out the less virile chicks which would otherwise have failed to survive. The remedy is drastic inspection and culling, and this illustrates that the use of these modern methods is only for the experienced poultryman who knows both how to appreciate the labor-saving devices and to recognize their limitations. Doubts may exist as to the reliability of the supply, but there is no doubt that operation with electrical appliances is more convenient and pleasant than with any other type.

HARDWOODS OF THE SOUTH. U. S. Dept. Agr., Forest Serv., Forest Prod. Lab., 1935, pp. 16, figs. 14. Southern hardwoods are discussed briefly with reference to texture, planing, shaping, turning, bending, warping, cross grain, seasoning, splitting, nail holding, screw holding, gluing, and odor and taste.

AMERICAN FARM BUREAU FEDERATION, INSTITUTE OF IRRIGATION AGRICULTURE, FOURTH WATER USERS CONFERENCE, Los Angeles, Feb. 25-27, 1935. Chicago: Amer. Farm Bur. Fed., 1935, pp. [3] + 99, pl. 1. This institute included, among others, special papers on Underground Water, by H. Conkling; The Use of Power on Irrigation Projects, by C. L. Childers; Underground Water, by J. J. Deuel; Measures Taken to Alleviate the Effects of the Drought of 1934, by W. W. McLaughlin; and The Movement and Control of Underground Water, by W. Peterson.

AMERICAN SOCIETY OF CIVIL ENGINEERS, REPORT ON PROGRESS CONFERENCE ON WATER CONSERVATION, Los Angeles, Mar. 13, 14, 1935. Los Angeles: Amer. Soc. Civ. Engin., 1935, pp. [3] + 120. This report presented by the committee on conservation of water, of the irrigation division of the American Society of Civil Engineers, contains special papers and reports on Evaporation Studies in Southern California, by H. F. Blaney and A. A. Young; Use of a Limited Water Supply for Irrigating Citrus Orchards, by C. A. Taylor; Law of Underground Waters, by H. Conkling; Economic Limits of Conservation of Flood Water by Spreading, by K. Q. Volk; Runoff from Small Experimental Plots, by F. B. Laverty; Measurement of Debris Transported from Burned Areas, by C. W. Sopp; Check Dams, by P. Bauman; Erosion Control, by H. E. Reddick; Forest Influence Studies at the San Dimas Experimental Forest, by E. I. Kotok; Safeguards on Denuded Watersheds, by W. V. Mendenhall; Runoff and Erosion Experiments in Mountain Areas, by C. J. Kraebel; and Erosion and Runoff Experiments from Cultivated Areas, by L. A. Jones.

MINIMIZING WOOD SHRINKAGE AND SWELLING, *A. J. Stamm* and *L. A. Hansen.* Indus. and Engin. Chem., 27 (1935), No. 12, pp. 1480-1484, fig. 1. In a report of studies at the USDA Forest Products Laboratory it is pointed out that when either green or dry wood is impregnated with a water-insoluble oil, or molten wax, or resin, the impregnating material merely enters the microscopically visible capillary structure. Water in the fine swollen structure of the cell wall can, however, be replaced by a liquid which is completely miscible with water. This liquid, if also a solvent for waxes and resins, can be replaced by the latter at temperatures above the melting point. This procedure has been used for getting water-insoluble waxes, oils, and resins into the intimate structure of the cell wall using Cellosolve as the intermediate solvent. Only a partial shrinkage of the wood from the green condition occurs, and the subsequent dimension changes with changes in equilibrium relative humidity are materially reduced. The process can thus serve as a combined seasoning and antishrink impregnation treatment for refractory species. Data obtained by the ordinary impregnation method and data obtained by impregnating dry wood with the waxes and resins dissolved in wood swelling solvents, are given for comparison.

SYMPOSIUM ON PAINT AND PAINT MATERIALS. Philadelphia: Amer. Soc. Testing Materials, 1935, pp. [5] + 150, fig. 1. This symposium includes special articles on preparation, use, and abuse of specifications for paint materials, by P. H. Walker; paint testing, by C. D. Holley; varnish testing, by W. R. Fuller; lacquer testing, by H. E. Eastlack; drying oils, by S. O. Sorensen; zinc pigments, by E. H. Bunce; lead pigments, by R. L. Hallett and C. H. Rose; titanium pigments, by I. D. Hagar; the mineral earth colors and synthetic iron oxides, by J. W. Ayers; chemical colors, by A. F. Brown; natural and synthetic resins, by W. T. Pearce; lacquer solvents and volatile thinners, by R. M. Carter; and turpentine and petroleum distillates as thinners for varnish and paint, by J. M. Schantz. *(Continued on page 86)*

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EROSION CONTROL ON MOUNTAIN ROADS, *C. J. Kraebel.* U. S. Dept. Agr. Circ. 380 (1936), pp. 45, pls. 15, figs. 6. The purpose of this circular is to indicate erosion-preventive measures which can be incorporated in the planning and building of mountain roads and to describe corrective measures which are applicable particularly to California conditions.

Appendixes are included on examples of road erosion in California—damage caused and quantities of soil moved; estimated specifications for labor, equipment, and materials; outline of procedure in contour wattling; forms for reconnaissance and cost records; planting districts and plant lists; and notes on handling and sowing seed.

AGRICULTURAL ENGINEERING INVESTIGATIONS AT THE OHIO STATION, *C. O. Reed, R. M. Salter, E. E. Barnes,* and *E. A. Silver.* Ohio Sta. Bul. 561 (1936), pp. 120-125, figs. 2. The progress results are briefly presented of fertilizer tests with corn planters and of investigations on the mechanical and biological processing of feeds for cattle.

ALCOHOL AND ALCOHOL-GASOLINE BLENDS AS FUEL FOR AUTOMOTIVE ENGINES. — V, STUDIES ON THE PERFORMANCE OF AN EIGHT-CYLINDER ENGINE USING GASOLINE, DEHYDRATED ALCOHOL, AND DEHYDRATED ALCOHOL-GASOLINE MIXTURES, *A. L. Teodoro.* Philippine Agr., 24 (1936), No. 10 pp. 839-853, figs. 8. Studies are reported the purpose of which was to compare the performance characteristics of gasoline, dehydrated alcohol, and dehydrated alcohol-gasoline mixtures when used as fuels in an 8-cylinder engine. The important points considered were ease of starting, fuel consumption, maximum power developed, and general behavior of the engine at full and at fractional loads when tested on the block.

Dehydrated alcohol of strength 98.5 per cent by volume, denatured with about 5 per cent sulfuric ether, proved to be an efficient and excellent fuel for an 8-cylinder automobile engine having a compression ratio of 6.33 : 1. Mixtures of this alcohol and of gasoline in different proportions by volume were found miscible under the conditions in which they were tested. No sign of separation of the fuels was noted when the temperature of the liquid was lowered to 15 C. Mixing dehydrated alcohol with gasoline minimized, if it did not entirely suppress, the tendency of gasoline to detonate. Engine operation at full throttle on gasoline showed evidence of detonation at all speeds. With the mixture containing 10 per cent dehydrated alcohol, detonation at this load was heard at the lowest running speed only. No difficulty in starting from cold was experienced with any of the fuels used. When the engine was not yet warmed up, in order to maintain a steady running operation with the use of mixtures containing more than 40 per cent dehydrated alcohol, it was found to be necessary to close the choke partially for a few seconds.

Relatively greater power could be developed with the use of dehydrated alcohol and with mixtures containing at least 60 per cent dehydrated alcohol than with the use of gasoline. At speeds below 400 rpm, operation on mixtures containing at least 30 per cent dehydrated alcohol was characterized by jerky movements and by decreasing load after 3 min of running.

Fuel mixture containing 10 per cent dehydrated alcohol gave just as much fuel economy, if not more, as gasoline at all loads, except at one-half where an increase in consumption was noted as the percentage of dehydrated alcohol in the mixture was increased. Using the mixture containing 10 per cent dehydrated alcohol as a basis, the percentage increase in fuel consumption per every 10-per cent increase of dehydrated alcohol in the mixture, was about 4 to 5 per cent at full load, 5 to 6 per cent at three-fourths load, about 6 per cent at one-half load, and from 5 to 7 per cent at one-fourth load.

ALCOHOL AND ALCOHOL-GASOLINE BLENDS AS FUELS FOR AUTOMOTIVE ENGINE.—IV, PERFORMANCE CHARACTERISTICS OF ALCOHOL, ALCOHOL-GASOLINE MIXTURES, AND GASOLINE AS MOTOR FUELS UNDER DIFFERENT ROAD CONDITIONS, *A. L. Teodoro, A. B. Catambay, E. K. Ongsansoy, and J. P. Mamisao.* Philippine Agr. 24 (1936), No. 9, pp. 763-775, figs. 2. Studies are reported of fuel and oil consumption and performance of a truck and automobile under different road conditions using alcohol, gasoline-alcohol mixtures, and gasoline as fuels. Two kinds of alcohol were used, namely, (1) denatured, dehydrated alcohol having a purity of 193 proof, and (2) Alkohl motor fuel No. 8 containing 100 parts by volume of 190 proof ethyl alcohol plus 3 parts by volume of gasoline. V-8 engines were used in both cases.

With gasoline as 100 per cent, the minimum efficiency obtained with the use of Alkohl motor fuel No. 8 was 57.5 per cent and the maximum 83.6 per cent. A fair weighted average was about 73 per cent.

An alcohol-gasoline mixture containing 5 per cent by volume of denatured, dehydrated 193 proof ethyl alcohol gave practically the same mileage as gasoline. Since detonation was minimized with the addition of alcohol, the efficiency of the mixture on hilly roads, where gasoline showed evidence of knocking, was higher by about 2 per cent than gasoline. The use of mixtures containing from 10 to 20 per cent by volume of denatured, dehydrated, 193 proof ethyl alcohol exceeded the efficiency of gasoline by an amount varying from 0.7 to 16.8 per cent. Some tests showed that the efficiency of the mixture increased as the percentage of alcohol in the mixture was increased to 15 per cent. The performance of the engine using a mixture containing 20 per cent by volume of denatured, dehydrated, 193 proof alcohol was characterized by slower acceleration on low speeds and by rather poor idling.

It was indicated that the oil consumption expressed in cubic centimeters per 100 ton-km was about 10 per cent higher in the use of Alkohl motor fuel No. 8 than in gasoline. Starting from cold, using Alkohl motor fuel No. 8, was not so fast as with the use of gasoline. Without any change in the engine adjustment, road performance with the use of mixtures containing as high as 15 per cent denatured, dehydrated, 193 proof ethyl alcohol was practically the same as gasoline.

FIRE RESISTANCE OF SOME FLOOR CONSTRUCTIONS SUPPORTED BY STEEL BEAMS AND THEORETICAL DETERMINATION OF TIME-TEMPERATURE CURVES, *R. Schlyter* and *N. Odemark.* Statens Provningsanst., Stockholm, Meddel. 65 (1935), pp. 51, figs. 27; Eng. abs., pp. 45-51. The results of a series of fire tests are reported which were conducted by the Swedish Testing Institute at Stockholm to determine the fire-resistance capacity of different types of steel beams enclosed partly or wholly in concrete. The specific aims of the tests were to determine (1) whether a steel beam encased in concrete with the lower flange unprotected could be considered a suitable construction from the point of view of fire resistance, (2) whether the demand for insulation of the lower flange with a covering of 4 cm of concrete might be considered justified for ordinary fire-resisting buildings, and (3) whether the lower flange of the steel beams unprotected by concrete could possibly be suitably protected by eternit slabs, or by remaining wooden boards covered with reeds and plaster, reeding fixed with extra iron netting, or by a combination of eternit-tretong slab laid on remaining wooden boards covered with reeds and plaster. For the testing of walls the Institute has standardized a method of testing in a vertical furnace.

The results of the test in regard to the temperatures in different layers of the structures, as well as deflections and changes in length, are graphically presented. As to how long the boards with reeding and plaster on the underside of the steel beam structure protect the steel from fire, the test showed that the temperature in the lower flange rose very slowly so long as the plaster and wooden paneling adhered. This was due to the favorable insulating capacity of the wooden paneling. Up to the moment when the wooden paneling was burned away the temperature of the lower flange did not exceed 100 to 150 C (degrees Centigrade). The temperature rose rapidly when the plaster and the insulating panel had burned away. After from 20 to 30 min the temperature between plaster and wood was 300 C, at which time the first crack rose in the plaster, through which the gases generated by the dry distillation of the wood forced their way. Wooden paneling, reeding, and plaster could not be calculated to protect the steel from direct contact with the fire for more than from 40 to 50 min.

A method also is presented whereby the complex mathematical formulas involved in the calculation of the rise in temperature in a wall under test as to its fire-resistant qualities may be solved graphically. It is also shown how the necessary coefficients for the practical use of this method can be determined by a comparison between temperature curves determined in an experimental way at fire tests and theoretical curves determind by graphical calculation.

BETTER PLOWING, *T. Cleaver* and *R. I. Shawl.* Illinois Sta. Circ. 450 (1936), pp. 40, figs. 24. This circular prepared in cooperation with the USDA Bureau of Agricultural Engineering includes sections on factors in good plowing, need for good trash coverage, field practices before plowing, choice of plows and plow parts, plow attachments and their adjustment, hitches and wheel adjustments, and selecting a new plow. *(Continued on page 94)*

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PRACTICAL ASPECTS OF FLOOD CONTROL AND RECLAMATION OF OVERFLOWED LANDS, *A. G. Classen*. Tex. State Reclam. Dept. Bul. 27 (1935), pp. VIII + 80, figs. 38. This is a brief discussion of flood control and reclamation as a source of pertinent information for those interested in the development of flood control and prevention projects on the smaller rivers and streams. The principal part of the discussion treats with the proper design of floodways, channels, and interior drainage of levee improvement districts, and attempts to point out the chief reasons for errors and mistakes most common to this type of public improvement and methods of avoiding them.

Chapters are included on rainfall, runoff, and stream discharge; general plans and methods of flood control; surveys and investigations; the hydraulics and design of floodways and channel improvements; design and construction of levees; and interior drainage, sluice gates, and pumping plants.

A bibliography is included, the contents of which are recommended as reliable references on the subject.

SELECTION OF LUMBER FOR FARM AND HOME BUILDING, *C. V. Sweet* and *R. P. A. Johnson*. U. S. Dept. Agr., Farmers' Bul. 1756 (1936), pp. 11 + 46, figs. 16. Practical information is given on the selection of lumber to meet the essential requirements of different buildings and on how different kinds of woods meet these requirements. Some principles of good construction also are presented.

RAINFALL, SOIL EROSION, AND RUNOFF IN SOUTH AFRICA, *W. R. Thompson*. Univ. Pretoria, ser. 1, No. 29 (1935), pp. 31, figs. 4. This report briefly reviews the literature on erosion and runoff control and presents the results of an experiment which has been in operation for 4 yr. The object is to test the amount of water lost through runoff and the amount of soil eroded from 10 differently treated plats. The selected slope is 3.75 ft in 100 ft. Each plat is 6 ft wide and 90 ft long.

During the course of the experiment the loss of water and soil, respectively, was from 80 to 683 times greater from the uncultivated bare plat as compared with that from the veld intact plat. Avoidance of bare space is therefore fundamental to erosion control. Soil erosion and runoff are concomitant with the growing of cultivated crops. Maize and cowpeas grown for grain bear this out on a 3.75 per cent slope. The cultivation of annual hay crops appears to be less detrimental. Teff grass prevents excessive erosion but permits runoff, especially at planting time and during the establishment period. The shallow root system of this crop and the short period it occupies the soil seem to account for the comparatively high runoff. Rhodes grass, representing perennial planted grasses, was most effective in preventing runoff and soil erosion. The establishment of planted grasses on lands subject to erosion is to be strongly advocated. Burning of surplus material (veld) annually increased bare space and encouraged runoff and soil erosion. The runoff was 27 times greater than that of a veld plat intact during a good rainfall season, 1933-34. This was the most undesirable veld treatment from this aspect.

Although close summer rotative grazing of veld with sheep increased runoff over and above veld left intact, it was less harmful than grazing and burning. It would appear that sympathetic grazing of veld will not increase runoff and soil erosion to a material extent. Overgrazing on the contrary will be decidedly harmful. Unused veld prevented runoff and soil erosion almost entirely on this slope. In two out of four seasons no runoff was recorded, while during the remaining two it was negligible. Fallowing appears to be unsuccessful in preventing runoff and erosion. Kraal manure, when applied to maize, affected a considerable decrease in runoff. The importance and effect of organic matter in runoff control is indicated. This is now being investigated more fully.

AGRICULTURAL ENGINEERING INVESTIGATIONS AT THE MASSACHUSETTS STATION, *C. I. Gunness L. A. Bradley, J. B. Belknap, and C. F. Clancy*. Massachusetts Sta. Bul. 327 (1936), pp. 8, 9, 22. The progress results are briefly presented of investigations on apple storages, low-lift pumps for cranberry bogs, and stream pollution by private and municipal raw sewage.

NEW JERSEY LAYING HOUSES, *E. R. Cross*. New Jersey Stas. Hints to Poultrymen 23 (1936), No. 4, pp. 4. Practical information is given on poultry house planning and construction for New Jersey conditions, including data on lighting, wall and floor construction, insulation, and ventilation. *(Continued on page 96)*

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READJUSTING MONTANA'S AGRICULTURE.—VI, MONTANA'S IRRIGATION RESOURCES, *P. L. Slagsvold.* Montana Sta. Bul. 315 (1936), pp. 18, figs. 4. This bulletin presents an inventory and analysis of the irrigation water resources of Montana in relation to agricultural adjustment in the state. It is pointed out that at present the irrigated area embraces about 2,000,000 acres of land scattered throughout the entire state. Much of this land is watered from seepage or from occasional floods, which makes it suitable only for hay. A large proportion of the remainder is subject to periodic or occasional water shortage, which prevents development of intensive farming. Without supplementary storage, much of the land cannot be put to its best use. The available water in readily accessible streams has been appropriated by private users or companies. In many cases these rights to water are distributed in such a way as to cause a wasteful and often detrimental use. Some areas could solve their water problem best by pooling the rights and making a complete change in the distribution system. Other areas need storage.

Where large irrigation works have to be constructed, either for new or supplemental development, the problems of costs, returns, and financing are significant, as are also the questions of the best method of assessing the costs in accordance with benefits received. Montana at present has no law which provides for spreading the burden of irrigation developments over the entire community.

The belief is expressed that much of the irrigation development in Montana in the next few years probably will take the form of greater intensification in the use of existing irrigated land, either through the development of supplemental water on major irrigation projects, reviving defunct irrigation districts and companies, or more intensive agriculture on a few large irrigated stock ranches.

THE NEW YORK STATE FLOOD OF JULY 1935, *H. Johnson.* U. S. Geol. Survey Water-Supply Paper 773-E (1936), pp. IV + 233-268, pls. 17, figs. 3. This report, prepared in cooperation with the Water Power and Control Commission of the Conservation Department and the Department of Public Works, State of New York, presents an engineering description of this flood as a part of the regular stream gaging work in New York.

OAK FLOORING: Commercial Standard CS56-36 Washington: U. S. Dept. Com., Bur. Standards, 1936, pp. II + 21, figs. 4. This standard provides minimum specifications for commercial grades of white oak and red oak flooring. It covers length, width, thickness, defects, and bundling and the grading tolerances for these requirements.

Correction Notice

IN the advertisement of the Owensboro Ditcher and Grader Company which appeared on page 48 of AGRICULTURAL ENGINEERING for January 1937, the two words "per mile" were omitted by error from the end of a sentence where they were needed to convey the meaning desired. The advertisement is the one headed "A Martin Message to Agricultural Engineers." The next to the last paragraph at the bottom of the text should start as follows: "Compare these Martin costs with those of large outfits running from $1.50 per acre to $4.50 per acre, and up to $75.00 *per mile.*"

EMPLOYMENT BULLETIN

The American Society of Agricultural Engineers conducts an employment service especially for the benefit of its members. Only Society members in good standing may insert notices under "Positions Wanted," or apply for positions under "Positions Open." Both non-members and members seeking to fill positions, for which ASAE members are qualified, are privileged to insert notices under "Positions Open," and to be referred to members listed under "Positions Wanted." Any notice in this bulletin will be inserted once and will thereafter be discontinued, unless additional insertions are requested. There is no charge for notices published in this bulletin. Requests for insertions should be addressed to ASAE, St. Joseph, Michigan.

POSITIONS WANTED

CIVIL ENGINEER, with two years agricultural engineering experience in soil conservation work, including SCS camp layout, design of small earth dams, terraces and outlets; layout of dimension ditches; drafting, blueprinting, filing, time study, general estimating; camp engineer work, including layout of field work for camp crews, general supervision of field foremen, design of erosion control structures, and preparation of reports. Also one year's experience in detailing reinforced concrete for buildings. Desires position in construction work or with machinery manufacturer in maintenance, demonstration, or research. Looking for permanent connection with opportunity for advancement. Location immaterial. Age 27. PW-272